AAU Forsknings og Innovationsindikator

Til fremme af AAU's Videnskabelige Publicering og Impact, Samarbejde, Synlighed og Åbenhed

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AALBORG UNIVERSITET

THE AAU RESEARCH AND INNOVATION INDICATOR

For the advancement of scientific publishing, impact, collaboration, visibility, and openness at Aalborg University

The Committee for the Development of a New Research and Innovation Indicator at Aalborg University

The report is drawn up by the Committee for the Development of a New Research and Innovation Indicator at Aalborg University.

Version history

	Date	Additions and changes
Version 2	August 2025	In June 2025, The Strategic Council for Research and Innovation decided to include innovation in the indicator. Innovation is included in part B of the indicator which is henceforth referred to as the AAU Research and Innovation Indicator. Additions and changes to the report are prepared by the VBN team in collaboration with AAU Innovation.
Version 1	December 2022	-

The report was translated into English by Lotte Stehouwer Øgaard.

SEPTEMBER 2025
Aalborg University

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SUMMARY

The need for a new Research and Innovation Indicator at AAU

In December 2021, the Danish Bibliometric Research Indicator (BFI), which has served as a national research indicator since 2009/2012, was abolished. Thus, June 2021 was the last time the Ministry of Higher Education and Science (UFM) awarded BFI points to Danish universities. AAU has used the calculation of BFI points as a measure of the departments' research production and distribution of part of the basic research funds. With the abolishment of the BFI system, AAU no longer has a research indicator that can be used internally at the university. Several studies suggest that the BFI model has had a positive impact on AAU's research production. Furthermore, during the period where the BFI model has been implemented at AAU, there has been a positive development in impact measured by citations, as well as by the proportion of publications in journals in BFI 2 level. AAU is the only Danish university that has managed to advance in all areas regarding number of journal articles, number of publications at BFI 2 level and number of citations. Part of this success is attributed to the prominent level of implementation of the BFI model at AAU.

AAU's Executive Board has assessed that there is a need for a new indicator to replace previous BFI calculations in the budget model, and to serve as a guide and tool at AAU. It is the wish of the Executive Board that the new indicator in its continuation preserves AAU's positive results from the BFI model with regards to the increase in the number of publications and the international impact of the publications. In addition, the new indicator must take the height and breadth across research disciplines into account, as well as being simple and transparent.

Open Science and Conventional Bibliometrics

International trends in research evaluation are increasingly addressing the need for an alternative/supplement to the conventional bibliometric research indicators such as Journal Impact Factor (JIF) and H-index, while pointing to the importance of making research assessments based on other more qualitative parameters such as openness to research results, visibility, and publication diversity. As one of the goals of the new indicator is precisely that it should be internationally recognizable and recognized, the committee has had the ambition to include some of these new parameters and develop concrete, qualitative indicators to the AAU Research and Innovation Indicator. Significant documents in this context are the San Francisco Declaration on Research Assessment (DORA) from 2012 and the European Union's most recent document on research evaluation from July 2022 Agreement on Reforming Research Assessment (ARRA).

AAU has already signed DORA, and the present committee recommends that AAU also signs ARRA. Signing the two agreements and incorporating the ideas into the AAU Research and Innovation Indicator, will place AAU at the forefront in terms of including the latest trends in research evaluation. This means that AAU - with the new indicator - is ready to meet new requirements from funders and foundations, national and international, including the EU.

The AAU Research and Innovation Indicator is based on two principles

Although both DORA and ARRA encourage an increased focus on open science parameters and more qualitative indicators, there is still a need for conventional bibliometrics to measure and assess research height, as well as breadth. Thus, the new indicator contains two parts; Part A concerning scientific publication, which uses bibliometric methods, and Part B, which accommodates research evaluation from an open science perspective. In Part B, these ideas are translated into three areas: *Collaboration, Visibility, and Openness*.

Part A – Scientific publishing

Part A is based on calculations of publication points as in the previous BFI model. Part A is based on complete data for scientific publishing from all disciplines, and the calculation ensures a balance between them. However, the new indicator is expanded with more publication types, as well as changes in some of the point rates for contribution to publications. At the same time, the indicator is developed to include citations wherever possible. When citations are used, the departments' coverage rate in the citation database Scopus is first calculated to accommodate publication differences across the departments. That is, it is considered that some departments have a large part of their research production indexed in Scopus, while others have a smaller part. The departments' coverage ratio is therefore calculated based on the departments' total research production in Pure. In the AAU Research and Innovation Indicator, citations are also only weighted for each department.

Part B - Collaboration, Visibility, and Openness

Part B is based on statistics and information at department level regarding collaboration, visibility, and openness in research practice. This part of the indicator uses a different type of data, which may be more incomplete in relation to what you want to measure, and where comparison between disciplines may be difficult. At the same time, Part B is important as it ensures that AAU's Research and Innovation Indicator includes perspectives from DORA (2012) and ARRA (2022), thereby ensuring that the indicator has the desired behaviour-changing effect in terms of understanding that research publishing and research impact can be measured using different indicators. The Committee proposes that the existing performance agreements should include reporting on this part of the indicator. For the departments to gain access to the part of the fund pool that is allocated for collaboration, visibility, and openness, it is required that there be a performance agreement approved by the Dean's Office. Since Part B of the indicator will require the greatest transformation in terms of implementation, including collection of data, the committee proposes that Part A takes up 70 percent in the economic distribution model, whereas Part B takes up 30 percent, and is used following a qualitative assessment of the strategy work. The Committee proposes an adjustment of the distribution of percentages between A and B on a regular basis.

RECOMMENDATIONS FOR IMPLEMENTATION

To implement the proposed indicator, it is necessary to gain an understanding of the motivation, elaboration, and application of the indicator. An implementation containing information, teaching, and guidance at management-, administration- and researcher level will introduce and emphasize the Research and Innovation Indicator as an incentive for researchers to increasingly incorporate new elements into the way they conduct and disseminate their research. The report proposes an implementation plan consisting of four components:

- Dissemination and Communication – internal and external
- Teaching – management level, department, and research group level

- Financial implementation – securing the new model in relation to the budget model and the internal distribution between faculties.
- Administrative implementation – security, validation and support of data and update of measurement methods within bibliometrics and citation databases etc.

At the same time, it is to be expected that the new Research and Innovation Indicator - particularly during the implementation phase - will require resources for calculation, quality assurance, as well as dissemination, communication, and teaching. A large part of this increased resource impact will be in the University Library's VBN team. Therefore, the committee proposes that the implementation of AAU's Research and Innovation Indicator is supported with resources corresponding to 1 FTE in a one-year project position with the possibility of extension for up to 3 years.

INTRODUCTION

Research evaluations are currently undergoing a development in which qualitative parameters to an increasing degree are included in the assessment of research and contribution to research. As part of this development, several documents and manifestos have been designed to attempt to inspire a more holistic mindset regarding research evaluations. There is an increasing focus on using accountability in the metrics used by universities, foundations, and agencies to evaluate research and researchers, e.g., in connection with recruitment and distribution of research funds.

A common reasoning in these documents is the idea of "responsible metrics" - a terminology particularly used by the EU in its latest approach to research evaluations from 2022. By using these metrics, research institutions want to ensure assessment of researchers and research on a fair basis, taking the differences in research disciplines into account and promoting diversity in research outputs and contributions. This method can support sound research indicators. By including several elements from ARRA and DORA and taking the differences between STEM and SSH faculties into account, AAU appears as a pioneer university in the work of using more responsible metrics for research evaluations on a well-informed and recognized basis.

Report format
This report presents proposals for the application of a new indicator at AAU. The report contains descriptions of the background and motivation for the development of a new indicator at AAU, the composition of the committee, and work processes. Likewise, the report contains a detailed description of how the new indicator is constructed and how the various parts of the indicator work. Furthermore, the report puts forward a proposal for an implementation plan for the indicator at AAU.

1.1. BACKGROUND AND MOTIVATION

In 2021, a new political agreement was reached regarding the distribution of basic funds for research. In December 2009, the Danish Bibliometric Research Indicator (BFI), which has served as a national research indicator since 2009/2012, was abolished. The Trade Committee, the BFI professional groups, and all tasks related to the BFI ceased as of 3 December 2021. At the same time, the process of distinguishing the levels of the BFI lists ceased. Thus, June 2021 was the last time the Ministry of Higher Education and Science (UFM) awarded BFI points to Danish universities.

Currently, there is no proposal for a new national research indicator. Even Denmark's new research portal NORA has no reports about research monitoring or research indicators. At the same time, various studies and data show that BFI had a positive effect on research production and -impact at AAU. Among other things, Mouritzen et al. concludes 2018 that:

> *"A key observation [...] is that the university that has implemented the BFI most intensively and has had the strongest growth in research production and productivity, is the only university that has had progress all around. Regardless of the chosen goal, AAU has increased its international impact over the period [...]" (266–67)*

Thus, AAU managed to increase the number of publications, publications in BFI level 2 journals, and the number of citations respectively during the review period. The development in BFI level 2 for AAU is reflected in Table 1, which shows a clear positive increase for AAU during the period 2015-2019.

Table 1 – Development of the share of BFI level 2 points. Source: BFI preservation files

	2015	2019	Development
AAU	42%	54%	29%
AU	60%	60%	0%
CBS	65%	75%	15%
DTU	58%	63%	9%
ITU	69%	64%	-7%
KU	61%	63%	3%
RUC	57%	62%	9%
SDU	55%	52%	-5%

At the same time, Mouritzen et al. point out that (2018) certain challenges in connection with the way the BFI model has been implemented at Danish universities, including AAU, where the implementation rate has been high and right down to the individual level. Implementing bibliometric metrics at the individual level can be problematic, as the fluctuations in data are often too large to calculate real development and impact in isolation. At this level it is recommended primarily to make qualitative assessments of the sum of activities and qualifications. This point is considered in the development of the new indicator as described in sections 2 and 3.

Based on the positive effects of the BFI model, and a strong focus on publishing and research production, it is considered appropriate to be able to monitor the development of AAU's research. Hence the university management's wish for the development of such a monitoring tool.

AAU's Research and Innovation Indicator will maintain reporting on publications as the core of research evaluation, in the sense of a set of metrics used to assess research production at AAU. The indicator must meet the requirement of being able to differentiate between STEM and SSH e.g., by using different metrics. At the same time, the management wants the preparations for the indicator to include a focus on how research and innovation indicators can be applied as tools to support AAU's strategy 2022-2026. The purpose is also to prepare an indicator that can be included in AAU's internal budget model based on existing data.

Research evaluations in an Open Science perspective

In recent years, an increased focus on new metrics has surfaced both nationally and internationally. In terms of new metrics and methods of measurement, the EU in particular focuses on open knowledge, including open science indicators where transparency and openness throughout the research process - e.g., open access to data and publications - is essential. Nationally, this work is monitored by the Ministry of Higher Education and Science by

means of the national open access indicator. Thus, AAU is measured by the proportion of publications with open access.

Different methods of research measurement can be applied to assess subject fields thereby achieving a better overall assessment of research height, breadth, and development. Knowledge from the measurement methods should be able to provide a picture of the extent of interdisciplinarity in research, thereby contributing to AAU's strategic efforts to increase the degree of integration between SSH and STEM.

The new indicator will enable an organisational change in behaviour, as development to an increasing degree will focus on how AAU and AAU researchers must adapt to a research reality where collaboration, visibility, and openness are key elements.

1.2. MANDATE AND ORGANIZATION

The Committee for the Development of a New Indicator has been set up by the Strategic Council for Research and Innovation (SRFI). The Committee has been set the task of preparing concrete proposals for indicators that can support AAU's desire to continue to monitor research production at AAU, and which take differences into account, as well as general publishing patterns, research- and dissemination practices across AAU.

In addition, SRFI wanted the development of an indicator that can be incorporated as a parameter in AAU's internal budget model. The Committee's tasks and overall responsibility was to:

- Establish criteria for high-quality research that reflect current international standards and consider the different publishing patterns of the scientific disciplines
- To clarify how these criteria are implemented differently across STEM and SSH
- Establish the criteria within AAU’s existing overall data sources
- Prepare a recommendation to SRFI based on its deliberations

Thus, the Committee's starting point has been to develop an indicator that could meet SRFI's wishes to continue to measure conventional bibliometric indicators and production, at the same time as incorporating parameters to ensure that AAU is ready to meet new international and national requirements from funders and foundations, as part of the development taking place in connection with new research evaluations.

The above suggests the need for an indicator that shows a more holistic and nuanced picture of research evaluation, and thereby incorporates thoughts from e.g. the EU and DORA regarding an increasing need to measure research not only using quantitative metrics such as JIF, H-index and citations, but also other forms of impact and visibility that are viewed in an open science perspective e.g. open access to research, collaboration, and diverse publication types .

Finally, SFRI wanted the indicator to be compiled within the existing overall data sources in Pure to the extent possible. This is to ensure that there is no large additional registration burden on the individual researcher.

Organization of the Committee
The Committee is composed of one representative from each of the four faculties. The appointment is made by the dean's offices that have each nominated a candidate for SRFI. Since then, an approval process has taken place in the SRFI. In addition, AAU Innovation provides one representative, and the VBN team (Aalborg University Library) and the Finance and Accounts Department provide two representatives each. Finally, the Committee has engaged Professor Gunnar Sivertsen from *The Nordic Institute for Studies in Innovation, Research and Education (Oslo)* as an external consultant, who contributes with knowledge and experience in bibliometric research evaluations.

The Committee held its first meeting on 14 September 2022 and had a final meeting on 1 December 2022. A total of four physical Committee meetings has been held with all members of the Committee, as well as four physical preliminary meetings between the VBN team and the chair of the Committee, Jakob Stoustrup. In addition, there have been a series of workshops - online and with physical attendance.

MEMBERS OF THE COMMITTEE
Jakob Stoustrup, Chair
Vice Dean for Research and Innovation at the Technical Faculty of IT and Design and Representative of the Technical Faculty of IT and Design

Winnie Jensen
Deputy Head of Department for Research, Department of Health Science and Technology and Representative of the Faculty of Health and Medical Sciences

Torsten Nygård Kristensen
Deputy Head of Department for Research, Department of Health Science and Technology and Representative of the Faculty of Health and Medical Sciences

Birger Larsen
Professor at the Department of Communication and Psychology and Representative of the Faculty of Humanities and Social Sciences

Tommy Nielsen
Senior consultant and representative of the Finance and Accounts Department

Christian Müller
Specialist coordinator and representative of the Finance and Accounts Department

Jørgen Albretsen
Academic officer and Representative of AAU Innovation

Poul Meier Melchiorsen
Chief Consultant and Representative of the VBN Team

Kathrine Bjerg Bennike
Special consultant and Representative of the VBN Team

Gunnar Sivertsen (external consultant)
Professor at the Nordic Institute for Studies in Innovation, Research and Education (Oslo)

1.3. CONSULTATION PROCESS

The work on the development of a new indicator has taken place in an open process where there has been a desire for transparency. The initial development work has been visible, and relevant parties have been included in the work process to ensure transparency, and to be able to incorporate points to the design of the indicator. At the first Committee meeting on 14 September 2022, a news item was issued in AAU Update regarding the start of the project with explanations regarding tasks, the composition of the committee, and the goal of the committee's work.

In November, there were presentations in all four Academic Councils at AAU introducing the work on the indicator. The Committee has incorporated comments and input from the Academic Councils wherever possible. The work on the indicator is also set to be presented at the Main Joint Consultation Committee (HSU) on 13 December 2022.

In addition to the consultation process, which has aimed at getting special input from the Academic Councils in relation to opportunities and challenges for different academic disciplines, there will be a formal consultation process in the spring of 2023, where the definitive version of the indicator will be ready for presentation and comments.

Further processing of the indicator is as follows:

5 January 2023 – SRFI considers new Research Indicator
8 February 2023 – First reading by the Executive Board
Mid-April 2023 – Consultation Academic Council
Mid-April 2023 – Consultation Main Joint Consultation Committee (HSU)
17 May 2023 – Possible second reading by the Executive Board
22 June 2023 – Consideration by the Board of Directors

1.4. CONCEPTS AND DEFINITIONS

The Committee has made the following suggestions for the new name of the indicator:

In 2025, the Strategic Council for Research and Innovation decided to expand the indicator to include contributions in innovation hence the new name of the indicator.

AAU Research and Innovation Indicator - For the *Advancement of Scientific Publishing, Impact, Collaboration, Visibility, Openness and Innovation* at Aalborg University

AAU Research and Innovation Indicator - For the *Advancement of Scientific Publishing, Impact, Collaboration, Visibility, Openness and Innovation* at Aalborg University

The reason for the name is that the indicator must embrace the fact that the new AAU indicator includes more elements than the previous BFI model. This is to accommodate research differences across disciplines all the while being forward-looking in relation to increasing demands regarding the incorporation of alternatives to conventional bibliometric metrics from the EU in particular.

Quantitative and qualitative indicators

At the same time, this means that indicators in this report refer to both quantitative and qualitative evaluations of research. This is in line with DORA and the EU's understanding of research evaluations, which relies on a more qualitative approach to research evaluations. In addition, it is important that innovation, as part of AAU's DNA, appears as a principal element of how research is conducted at AAU. Including Innovation in the name highlights the importance of innovative elements as part of the way AAU excels nationally and internationally.

Open Science
In the context of research evaluation, the importance of including open science elements in the new indicator is to be forward-looking and to develop an indicator that is prepared for transforming thoughts, as well as current and future requirements from the EU, into practice. In addition, there is also a desire to reward researchers and departments that can adapt their behaviour and incorporate these elements. At the same time, open science is a broad term that is applied in different contexts and with different focus areas. A general perception of open science, and one which is used by the EU, is that open science encompasses the entire research process from beginning through funding and implementation of the research through data management, analysis, scientific publishing, and communication of the results.

In open science, open access to publications and datasets is one of the methods used to enable others to benefit from research achievements. In relation to open data, FAIR occurs as an essential element that is incorporated into research practice and data sharing to an increasing degree. The EU's open science mission is ambitious, and this means that the European Commission requires grant recipients of EU funds to do their part; "Publications available in open access and make their data as open as possible and as closed, as necessary. *It acknowledges and rewards the participation of citizens and end users*" (The European Commission, Nd.).

Collaboration, Visibility, and Openness
The Committee has worked to specify what is meant by open science in relation to the indicator. Here, open science is converted into thee focus areas: Collaboration, Visibility, and Openness.

The basis for these three parameters is that they are an essential part of the EU's work to reform research evaluation, *"Research assessment practices should induce a research culture that acknowledges* ***collaboration****,* ***openness****, and* ***engagement with society****, and that provides opportunities for multiple talents".* Collaboration, visibility, and openness interact well with EU perspectives and are consistent with AAU's strategic focus on being a university that advances in creating collaborative relationships with, among others, local, national, and international companies, and public institutions.

In addition, as described, it has been a goal of the SRFI that the indicator should try to use existing data to avoid increasing the registration burden on the individual researcher. Using the categories Collaboration, Visibility, and Openness ensures that existing data is available in Pure, which will be the primary source of data and information. The section on cooperation, visibility, and openness contains concrete examples of the contents of the three categories.

Journal Impact Factor (JIF)
A journal impact factor is a journal metric that refers to an average level of citations.

H-Index
H-index is an index that measures a researcher's scientific output and influence (citations) in one measure.

Field-Weighted Citation Impact
Field-Weighted Citation Impact is calculated based on Scopus data, and the metric takes differences in academic disciplines into account. FWCI is the ratio of the total number of citations received by a group of publications to the expected number of citations of publications based on the research area average. It is a way of measuring how the number of citations for a set of publications compares to the average number of similar publications in Scopus. An FWCI over one (1) means that you receive more citations than the world average within a given scientific field.

Scopus
Scopus is a citation database owned by Elsevier. Via Scopus, it is possible to calculate citations and make research analyses. In 2022, over 44,000 journals were indexed in Scopus, making it one of the largest citation databases globally.

Google Scholar
Through Google Scholar, it is possible for researchers to create a profile that can capture research production and citations.

PlumX
PlumX is a system that can provide insight into diverse ways in which research is applied and made visible online. For example, by measuring Clicks, Likes, Tweets, Bookmarks, etc. (PlumX Analytics, n.d.).

Pure
Pure is AAU's research registration system. It is in this system that all AAU's research production is registered and can be disseminated via the associated research VBN. Pure is also categorized as an institutional repository (Elsevier n.d.).

2. PURPOSE AND MAIN PRINCIPLES

The AAU Research and Innovation Indicator must 1) support the university's internal distribution of basic research funding, and 2) be useful in designing and following up on research strategies at department level. Aalborg University has previously used the National Bibliometric Research Indicator (BFI) for the same internal purposes, but with a more limited application in the work on research strategies. Unlike the BFI, the AAU indicator consists of two parts:

A. The calculation of publication points has changed. It provides an improved balance between disciplines and includes citations wherever possible.

B. Bibliometrics is no longer used in isolation but supplemented by qualitative measures that allow departments to include statistics and information regarding results of innovation and about collaboration, visibility, and openness in research practice.

While Part A can be based on complete data for scientific publication from all scientific disciplines, and the calculation ensures a balance between them, Part B is based on sources of information that may be incomplete in relation to what you want to measure and where it may be difficult to compare subject areas. Consequently, it proposed that Part A takes up 70 percent of the economic distribution model and is used directly, while Part B takes up 30 percent and is used indirectly following a qualitative assessment of the strategy work.

These main principles relate to the mandate and are inspired by the University's own experiences, needs, and strategic goals. This combined model resembles Proposal 4 (a combination of development contracts and indicators) of the report *Future-Proofing Research Quality*. The report recommends that publication points are modified by a citation indicator, which is part of the solution in Part A of the Research and Innovation Indicator. Part B is inspired by the new *European Agreement on Reform of Research Assessment* (ARRA, 2022), which calls for recognition of the diversity of other research contributions in addition to scientific publications:

> *valuable contributions that researchers make to science and for the benefit of society, including various outputs beyond journal publications and irrespective of the language in which they are communicated; practices that contribute to robustness, openness, transparency, and the inclusiveness of research and the research process including: peer review, teamwork and collaboration [...]* (Coalition for Advancing Research Assessment 2022, 5)

In addition to being consistent with ARRA, the division of the indicator into a bibliometrics part (Part A) and a qualitative part (Part B) is in line with another point from the report on *Future-Proofing Research Quality*. The report describes how universities and research institutions can work with evaluations in a *summative* perspective to show the professional level of research, as well as a formative perspective that may point to how research environments can improve quality and strengthen themselves in the future.

2.1. DESIGN PRINCIPLES FOR THE BIBLIOMETRIC PART

It provides an improved balance between disciplines and includes citations wherever possible. It has been paramount to create a design that rests on international research in quantitative studies of research, and to choose empirically proven solutions. The calculations may seem technically complex, but they are verifiable and simple to explain.

Why include citations? The report *Future-Proofing Research Quality* (Uddannelses- og Forskningsministeriet 2019) cites a number of reasons. One of them being the result of dialogue with the universities: *"At the same time, a citation-based indicator will be in line with goals already used by a number of scientific disciplines. Thus, it addresses a wish from several universities*." It also states:

> *Including citations as an indicator creates an incentive for researchers to publish in collaboration with researchers in internationally leading environments and to engage in international co-publishing to increase their citation level in general.*

At the same time, it creates an incentive to publish in esteemed journals. A study of 22,000 scientific articles in Norway showed a twofold increase in citation rate among level 2 articles compared to level 1 articles. The Danish BFI model's division of publishing channels into three levels is not included in the bibliometric Part A of the AAU Research and Innovation Indicator directly but is replaced by the citation-based indicator. This solves two problems. One, that publishing channels are no longer assessed by Danish expert bodies. Two, it meets the recommendation from ARRA (2022) and the DORA declaration (2012) to avoid evaluating individual articles based on where they have been published, e.g., by means of Journal Impact Factor. At any rate, the AAU Research and Innovation Indicator takes a general strategic wish for publishing in esteemed journals into account, as Part B contains statistics showing the department's share of articles in the journals assessed at high level in Finland and Norway. These statistics are not used directly in Part A.

However, although this solves two problems three others arise once you include citations. Two of these are mentioned in the report *Future-Proofing Research Quality* (Uddannelses- og Forskningsministeriet 2019):

> *The disadvantage of a citation indicator is that it is retrospective. Furthermore, it is not sufficiently comprehensive for all universities and research areas, as the citation indicator has a low coverage of certain areas, including, for example, the humanities and parts of the social sciences. Furthermore, citations do not include all publication types, including books and publications in Danish.*

Regarding the first problem of calculating citation rate after a few years, this is managed by the AAU Research and Innovation Indicator as previously documented citation rates at department level are used to modify the most recent year's total publication score at the same level. (See Equation 2 and Equation 4).

With the second problem, coverage rate, comes a third - viz. that scientific disciplines have different opportunities to obtain citations. Google Scholar is known to have the highest coverage rate, but it lacks the possibility of solving the third problem in a scientifically responsible manner. Both problems can be solved by using *Scopus* as the data source.

Coverage rate calculation is based on the department's proportion of scientific publications in AAU's research registration system Pure that matches the indexed publications in Scopus. The coverage ratio is used to determine how much of the department's total publication score should be "exposed" to modification by the citation indicator. This implies that citations are only used in the indicator when it is relevant and valid for the scientific field (See Equation 2).

The citation indicator is based on the well-established *Field-Weighted Citation Indicator* (FWCI): The citation indicator is based on the well-established *Field-Weighted Citation Indicator (FWCI)*: *"In practice, one typically corrects for the effects of the field of a publication, the year in which a publication appeared, and sometimes also the document type of a publication".* The same indicator is also known as the Mean Normalized Citation Score (MNCS) in the Leiden ranking: "*An MNCS value of two for instance means that the publications of a university have been cited twice above the average of their field and publication year*." The most common method is to compare the observed number of citations for an article with the average for articles from the same year and the same discipline in the database, i.e., a "world average". This method is used in the AAU Research and Innovation Indicator (See Equation 5).

The Research and Innovation Indicator does not calculate publication points in quite the same way as the BFI model. It includes more publication types, and they are weighted differently, see Table 2 with comments. The most significant difference, however, is that publications are shared between authors in a different manner when there is more than one author. The two most well-known counting methods are either to credit one publication to each author (whole counting) or to divide it between them based on the number of authors (fractional counting). The latter was used in the BFI model. It was also applied in the corresponding Norwegian indicator until 2015. Before that, the Danish Centre for Studies in Research and Research Policy at Aarhus University evaluated the Norwegian indicator and found that none of the methods balanced between disciplines with different authorship practices. The fraction gave more points to subject disciplines with fewer numbers of authors per publication: humanities and social sciences. Previously, Piro et al. (2013) made the same discovery. From 2015, the Norwegian authorities implemented a method that turned out to improve the balance between whole counting and fractional counting, by using the square root of the fraction (which increases it) instead of the fraction. The same method has been shown to work better in a larger bibliometric study that is mathematically substantiated. Thus, the use of the square root is purely empirically based, but with satisfactory results based on historical data.

In a global survey among active researchers, interviewees were asked to indicate how they could best describe their contribution to scientifically published teamwork. Once again, the balanced method gives a more accurate reflection of the individual researcher's contribution than was the case with the two traditional methods. The explanation is that teamwork requires overlapping responsibilities and organization. The AAU Research and Innovation Indicator uses the new method to ensure that the calculation balances between the scientific disciplines.

Thus, the bibliometric component of the indicator has changed significantly: Citations are included and normalized in terms of year and scientific discipline, Scopus coverage is calculated, and author shares are calculated by square root. This adds up to a more complex formula (see Equation 1 – Equation 4) as explained here in words:

1) Firstly, publication points for the individual publication are calculated based on publication type (e.g., journal article) and citation weight. The calculation is not (as in the BFI model) dependent on the level of the publishing channel. The point depends on

the given department's share in author contribution, e.g., two or six. The square root of a third is 0.58. The publication's points are multiplied by the square root of the department's author share. Secondly, all publication points are summed up to department level (see Equation 3).

2) Scopus coverage is calculated based on the sum of publication points, e.g., three quarters, which is the coverage rate.
3) The sum of publication points is multiplied by the coverage rate (e.g., 0.75) and by the citation indicator that compares with the world average (e.g., 1.10 if the number is 10 percent above average).

Finally, you add the remaining publication points, which are not covered in Scopus (0,25), and have not been modified by the citation indicator.

In practice, the calculations mean that the citation weight (FWCI) is calculated per publication wherever it makes sense cf. discussion regarding coverage. However, the AAU Research and Innovation Indicator only uses FWCI at department level. Thus, it is an aggregated citation number that is used in the indicator to calculate 70 percent. By using FWCI only as part of an overall departmental picture of citations, the AAU Research and Innovation Indicator meets the criticisms expressed by ARRA and DORA respectively regarding the use of bibliometric indicators at the individual level. Section 3 contains further examples of calculations and explanations for calculating FWCI and publication points.

2.2. DESIGN PRINCIPLES FOR THE STRATEGIC PART

Not everything that is worth measuring or knowing, in a research strategic context at department level, will appear in indicators that are based on complete and comparable data. There may be important activities that display research in the media that can e.g., be measured in terms of number of press cuttings, or contributions to innovation that can be measured in e.g., number of patents. Press cuttings and patents fail to cover societal contact or innovation completely and will necessarily vary between disciplines. Nevertheless, it is possible to include statistics, regarding the full scope of activities you want to support, in the formulation of strategies and evaluations of results at department level although these have no direct impact on funding.

Quantitative information primarily makes sense when included in qualitative descriptions of goals and achievements. Qualitative descriptions may also involve documentation other than statistics, such as overviews (e.g., of departments' agreements with organisations in the public sector and the business community) and examples (departments' initiatives to increase open research practice).

Thus, the main principles for the design of the strategic Part B are:

- Best possible coverage of relevant activities, regardless of the degree to which they can be measured and compared.
- In addition to statistics, such as overviews of the proportion of publications in ranking journals, documentation may include overviews and examples of e.g., memberships in national and international councils.
- Documentation should not merely sum up activities of the individual researchers but also reflect initiative and priorities at the organisational level.
- The documentation must be included in argumentative texts (narratives).
- The strategic component must mirror the university's short- and long-term goals. In addition, ARRA (2022) has been used as a source of inspiration.

- Thus, the strategic component is dynamic and must be subject to change as new types of documentation become available.

2.3. EXAMPLES OF PUBLISHING STRATEGIES IN SCIENTIFIC DISCIPLINES

The bibliometric Part A of the AAU Research and Innovation Indicator consists of publishing and impact, as well as publication level. Publishing and impact are measured by publication points, and publication level is indicated by high level publication on the lists of professionally recognized channels. If preferred, you can measure publication level using the journal indicators, which are calculated in the citation databases. The publication scores are determined by the following parameters: Number of publications, Scopus coverage rate, and the weighted citation index (FWCI). The options for changing the coverage rate in Scopus are limited. If the coverage is to be changed, it will require indexation of new journals in Scopus, or a change in the department's publishing practices in the direction of more journal articles in English in currently Scopus-indexed journals.

Methods and publishing patterns may vary from one research environment to the next. Therefore, the possibility of changing the coverage rate will vary from department to department. It must make sense to work with the coverage rate, and it can do so in cases where you create greater impact and improved dissemination of research from AAU by publishing in Scopus-indexed journals. If the choice should be between a journal that is not indexed in Scopus but has greater visibility and impact than the possibilities available in Scopus, then the choice must be the journal outside Scopus. Subsequently, you can work towards an indexation in Scopus.

"The classical SSH researcher"
Within a substantial number of SSH research disciplines, research practice involves publishing a larger number of chapters in books, books, and anthologies. These are not represented to any significant degree in Scopus. Books, anthologies, and book chapters in English, which may have a high international impact, will not be able to document a similar weighted citation index (FWCI). However, anthology editors now receive points in the AAU Research and Innovation Indicator, and book chapters receive 1 point. In the previous BFI model, the editorial work was not included, and book chapters were awarded 0.5 points. Inclusion of editorial work and the increase in point for book chapters will henceforth apply to Danish-language publications as well.

It will apply to both journal articles and books that online communication about these will increase visibility and impact, and this will be documented in the form of online media metrics (PlumX).

"The classical STEM researcher"
The STEM disciplines typically publish their articles in English language journals. These will document citations to a great extent. Within these disciplines, one strategy is to make sure that the journals selected are indexed in Scopus. If possible, you select journals ranking as high impact journals, "Journal Impact Factor", as these are more likely to improve the possibility for citations than journals with low impact. Online communication regarding the publications will further increase the impact.

In addition, within some STEM disciplines it is common...
To publish English-language journal articles and a considerable amount of conference proceeding articles. It is quite common that conference articles have a lower weighted citation index (FWCI) than journal articles. In such cases, a strategic step would be to move from

publishing in conference proceedings to publishing in Scopus indexed journals. However, there are always exceptions, and it is therefore important that the department is aware of its own research and publishing practices while considering how the new AAU indicator works.

3. THE AAU RESEARCH AND INNOVATION INDICATOR

When put together, the two main parts of the new indicator will contribute to an overall picture of AAU's research production, dissemination, and impact on society.
The AAU Research and Innovation Indicator consists of two main parts: publication points (Part A) and research statistics (Part B). Both can be included in the individual department's performance agreement. This is illustrated in Figure 1 by the dark blue colour. Publication points and statistics are further unfolded in the sections below.

The publication points (Part A) account for 70 percent of the indicator and research statistics (Part B) for 30 percent. To trigger the 30 percent in Part B, it is a requirement that the department has a performance agreement approved by the dean's office. On a long-term basis, it will be possible to adjust the distribution, as the elements covered in the statistics take up more (or less) space in research evaluation in general.

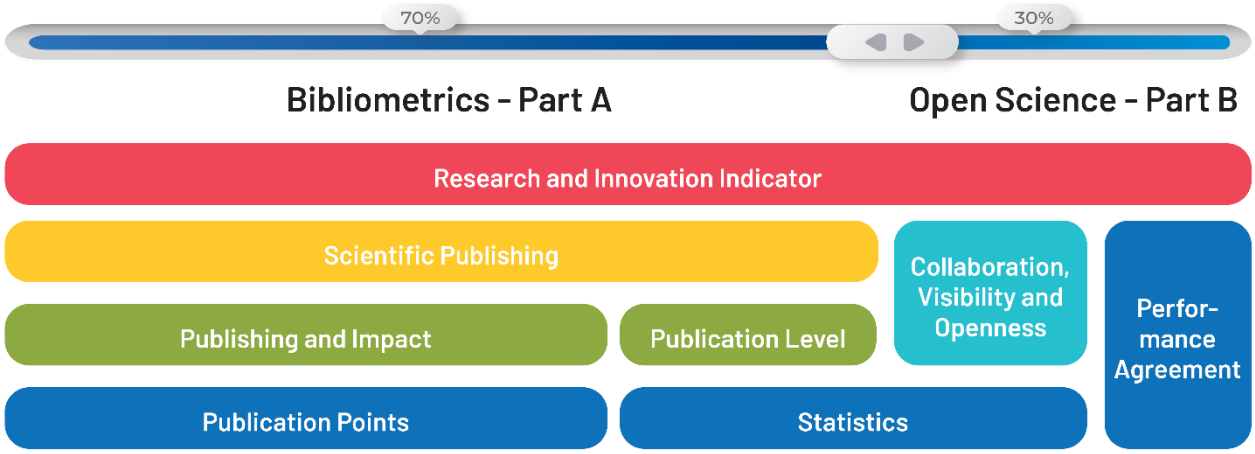

Figure 1 - AAU Research and Innovation Indicator

In the following section, the two parts are described; including specification of how the points are calculated and distributed, and with concrete examples.

3.1. PART A – SCIENTIFIC PUBLISHING

The elements of this part of the Research and Innovation Indicator consist of "Publishing and impact" and "Publication level". Publication and impact are included in the publication points, while the level of publication is reflected in the statistics provided by the indicator. The element

"Scientific publications" attempts to answer the questions "how many publications have researchers at a department published?", "To what extent are the department's publications cited?" and "How do the journals and publishers used by the department's researchers rank?"

Publishing and impact

The publication points are an expression of *quantity* in the sense of the number of publications published each year with researchers from a given department. At the same time, the points indicate a degree of impact for the department's publications. The number of publications is weighted by a citation index. However, the impact of research and the citing of publications merely constitute one element of the *quality* of this research. Research quality is a multidimensional concept in which plausibility, originality, scientific and societal value constitute some of the other facets. Therefore, The AAU Research and Innovation Indicator not only include the number of publications and a weighting with citations. The statistics part may provide a broader perspective on the department's research and its quality.

The publications counted in the publication points are *peer-reviewed research publications*[1]. In Table 2, you can see which publication types are counted in the points. Most of these publication types were also included in the BFI model. In the AAU Research and Innovation Indicator, the publication types "Encyclopaedia article", "Anthology", "Editorial", and "Preprint" have been added to accommodate greater diversity in publication types and researcher roles (ARRA 2022). With the publication types "Anthology" and "Editorial", editorial work is granted a place in the indicator.

Table 2 - Basic points for publication types

Publication types that count in the AAU Research and Innovation indicator: Basic points *(B)*	
Journal article, Conference article in journal, Letter, Review, Contribution to book, Contribution to report, Conference article in proceeding	1
Book, Report, Doctoral thesis	5
Encyclopaedia article, Anthology, Editorial, Preprint	0.5
Patent:	2

The publication point (*P*) is based on the type of publication. Table 2 shows basic points obtained by diverse types of publications. The base point B is fractionated between contributors as shown in Equation 1, where *L* is the number of local authors in relation to the department for which points are calculated. *T* is the total number of authors on the publication. The fractionation of basic points is achieved when using the square root of the fraction *L/T* – also termed *modified (or balanced) fraction count.*

[1] Peer reviewed research publications are assigned the term "Peer review" as well as the publication types "Research" or "Consultation" in AAU's research registration system Pure.

Equation 1 – Fractionation of publication points

$$P = B\sqrt{\frac{L}{T}}$$

A one-sided focus on counting publications in research evaluations overlooks the importance of the impact of the research. Such a focus on quantity without the inclusion of qualitative aspects has been seen in the past with "publication inflation" as a result. This is reflected in the fact that the research is divided into, and published in, the *smallest possible units*. The AAU Research and Innovation Indicator should counteract this. The new indicator focuses on the university's research production, at the same time as it accommodates the wish for an overall assessment that includes research height. Specifically, this is achieved by weighing up the publication points with the department's citations over time. The formula for this is reflected in Equation 2.

Equation 2 – Citation-weighted publication points

$$P * W^{org}$$

Equation 3– Citation-weighted publication points at department level

$$W^{org} \sum P$$

The citation weight W^{org} is composed by an emphasis on publications that appear in the citation database Scopus and an emphasis on publications outside Scopus. The emphasis on publications outside Scopus is one (1), as it is not possible to obtain weighted citation figures for these publication channels. Thus, it is only publications that appear in Scopus that will have the publication points modified with a citation weight different from 1. Publications outside Scopus count without modification.

Equation 4 – Citation Weight

$$W^{org} = W^{Scopus} + W^{Non-Scopus} = (SC^{org} * FWCI^{org} + (1 - SC^{org}) * 1)$$

In Equation 4, *SC* is the coverage rate in Scopus (Scopus Coverage) for a given organization, and *FWCI i*s Field-Weighted Citation Impact for the organization. The department's coverage in Scopus is part of the department's peer-reviewed research publications, that can be retrieved in Scopus. The coverage ratio for publications is calculated for a five-year period in arrears in relation to the year for which publication points are calculated.

The citation weight in Equation 4 is applied where it makes sense, and you can count citations. The citation weight is not applied where it does not make sense. It also holds that for departments with a high coverage ratio; the citations will carry a correspondingly high weight. Conversely, departments with low coverage will have less weighted citations.

Field-Weighted Citation Impact is calculated based on Scopus data, and the metric takes differences in academic disciplines into account. FWCI is the ratio of the total number of citations received by a group of publications to the expected number of citations of publications

based on the research area average. It is a way of measuring how the number of citations for a set of publications compares to the average number of similar publications in Scopus. An FWCI over one (1) means that you receive more citations than the world average within a given scientific field. The specific formula for calculating FWCI for a single publication is displayed in Equation 5.

Equation 5 - field-weighted citation index

$$FWCI^i = c^i / e^i$$

where c^i = citations received by publication *i* in the year of publication and the following three years and e^i = the expected number of citations per publication received in the same period for similar publications. The FWCI of a department is calculated as the average of the FWCI of all the department's publications over the period for which it is calculated.

Examples of calculating weighted publication points (e.g., the department has 100 publication points):

- FWCI of 1.6 – 60 percent above the world average and a low coverage rate in Scopus (40 percent). In this case the department will receive 124 weighted publication points: 100 * 0.4 * 1.6 + (100 – (100 * 0.4)) = 40 * 1.6 + 60 = 124 points

- FWCI of 0.9 – 10 percent above the world average and a 40 percent coverage rate in Scopus. In this case the department will receive 96 weighted publication points: 100 * 0.4 * 0.9 + (100 – (100* 0.4)) = 40* 0.9 + 60 = 36 + 60 = 96 points

- FWCI of 0.9 – 10 percent above the world average and a 90 percent coverage rate in Scopus. In this case the department will receive 91 weighted publication points: 100 * 0.9 * 0.9 + (100 – (100* 0.9)) = 90* 0.9 + 10 = 81 + 20 = 91 points

Weighted publication points are calculated every year at the beginning of June for publications from the previous year. Both FWCI and Scopus coverage ratio for publications are calculated for a five-year period in arrears in relation to the year for which publication points are calculated. This means, for example, that points for publications published in 2022, where points are calculated in June 2023, are calculated with Scopus coverage for publications in the period 2018-2022 and FWCI for the period 2018-2022. Both Scopus' coverage ratio and FWCI are calculated at department level.

Professionally recognized publication channels

For a publication to trigger potential points in the AAU Research and Innovation Indicator, it must be peer-reviewed and published through a professionally recognised channel. This is required to maintain focus on the merit and quality of journals, series, and publishers.

Both Norway and Finland have current lists of professionally recognised publication channels, where it is possible for Danish researchers to make suggestions for new topics for the lists. The AAU Research and Innovation Indicator will apply the list that works best with AAU's research registration system in practice. In the new indicator, the VBN team will provide an overview to each department in connection with the distribution of points, indicating the number of publications at each level. As described earlier, this information regarding the publications can be included in the department's reporting in Part B.

- The Norwegian list: https://kanalregister.hkdir.no/
- The Finnish list: https://www.tsv.fi/julkaisufoorumi/haku.php?lang=en

Citation data – Scopus
Scopus covers more than half of AAU's research publications and has clear definitions of what constitutes its overall data sources. There are other citation databases such as Google Scholar and Web of Science, but the committee has chosen Scopus to achieve a high coverage based on solid data. Google Scholar has good coverage but lacks a clear definition of the overall data sources for citation counts in its database, and Google Scholar does not include the possibility for aggregated data extraction such as FWCI. Web of Science has a coverage that is slightly smaller or corresponds to Scopus' – now Scopus is considered the best bet for an overall data source for citation counting for use in the AAU Research and Innovation Indicator. The VBN team will continuously monitor developments within citation databases and assess whether there is reason for a change of practice.

Publishing level
ARRA (2022) contains the viewpoint that rather than emphasizing where a publication is published, one should value the impact of the publication. Journals' impact factors should not be used to assess the impact of individual publications. On the other hand, journal indicators are not worthless – they can be used to indicate something about the likelihood of achieving citations and impact when published in a particular journal. Journal indicators are also used to some extent by funds.

The publication level is omitted as a direct parameter in the publication point. However, the level of the channels through which they are published may indicate something about the probability of impact. Therefore, the levels of the publication channels are included as a parameter in the statistics part of the indicator. Levels from the Norwegian or Finnish lists can be applied. For example, you can examine the number of publications that is published at the lists' high level. Indicators calculated on data from citation databases can also be applied, and you may e.g., examine the share of publications published in the top 5 percent most cited journals. It is possible to examine the level of the department's publishing channels using several different tools and data sources.

3.2. PART B – COLLABORATION, VISIBILITY AND OPENNESS

Part B Collaboration, Visibility and Openness are juxtaposed to Scientific Publication in the AAU Research and Innovation Indicator – see Figure 1. This part does not use points but statistics for use in performance agreements and reports. Based on the available overall data sources at AAU, data is delivered in defined areas of collaboration, visibility, and openness. This statistical data is extracted from both Pure and AAU Innovation's systems and can be used for narratives regarding research, innovation and department focus areas. If necessary, external evaluations of the department can be incorporated into the generated data.
Table 3,

Table 4, and Table 5 list the overall data sources available for these parameters in the indicator. The tables state the extent to which the individual data types have been implemented and are in operation at AAU. The lists are not final, as other parameters may be considered that support

strategic work aimed at research collaboration and innovation projects, as well as visibility and openness in relation to the departments' research and events promoting innovation. Whenever propositions are made regarding new parameters and statistics, is should include an assessment of costs in terms of researcher's time spent on registration, as well as time spent on administration.

Collaboration
Publication records contain information about internal and external authors as well as their affiliations. Regarding internal authors, the department and faculty relations are generally present. External authors are displayed with their organization and country. This information can be found for activity and project registration to a certain extent. Thus, external collaboration on publications can be documented to a very high degree.

Activities and projects can show different and broader areas of collaboration than publications, which are primarily aimed at academia. There may be co-authors from public and private organisations. In terms of activities, it is possible to include memberships of networks, councils, boards, and other contexts in which researchers from AAU contribute. Project registrations have a broad scope and can contain many types of collaboration. At present, cooperation and external relations based on activity and project registrations will in some cases seem inadequate.

ARRA (2022) emphasises diversity in research roles and career pathways, as well as roles outside academia. This can be documented by co-publishing with people from public and private organizations. Students and technical administrative staff (TAP) are already included as authors on some of AAU's publications, and there is an existing practice at several departments for the inclusion of these research roles. It applies to both students and TAP that they will count as internal authors on publications.

Registration of innovation projects in Pure. The inclusion of innovation projects in the indicator and its credit-bearing framework is vital to furthering and acknowledging researchers' contribution to societal development. Innovation projects registered in Pure and tied to AAU Mission and Impact, as well as collaboration with non-academic organisations, constitute a significant part of the university's work with creating value outside academia. Registration and display of these projects will elucidate the university's strategic efforts in terms of providing research results with a practical and societal impact.
Through formal recognition of innovation projects as credit-bearing, researchers will have the incentive to engage in collaborations across sectors and focus on research with real-world impact. This will strengthen the university's profile and position as an academic institution that not only produces knowledge but contributes actively to solving societal challenges. Furthermore, systematic registration in Pure will provide local department management with a clear overview of current innovation projects. An overview that is highly relevant in terms of targeting strategic innovation initiatives and strengthening collaboration with external partners. A credit-bearing approach to innovation projects supports an academic culture in which researchers feel motivated and acknowledged for their engagement in activities that have real-world impact and contribute to the university's overall mission to further innovation and transfer of knowledge.

Referral and guidance in connection with AAU Startup Programme and project-oriented course in own startup (registered in the CRM and AAU Innovation). Research contributions are registered in the CRM upon active referral to an AAU Startup Programme in which their encouragement and assistance in trying out the business potential in project ideas form the

basis for innovation and setting up business. The indicator shows the researcher's role in furthering a culture where academic skills are integrated in innovation, and ideas are developed into viable businesses. This supports an innovative and enterprising culture in the academic environments where academic knowledge is transformed into groundbreaking solutions.

Table 3 - Collaboration

	Data	Coverage	Source + Degree of System Support	IMPLEMENTATION	Cost
External collaboration	Publications, activities and projects	100% for publications Varying for use for activities and projects.	Pure	Existing practice (publications) New practice (activities and projects) (registration required for memberships since 2021)	VBN team (existing task)
Internal collaboration	Publications and projects	100% for publications. Varying for projects	Pure	Existing practice (publications)	VBN team (existing task) Researchers (project registration new task)
Students	Publications	Varying to good	Pure	Existing practice at some departments	VBN team (existing/new task)
Non-academic staff	Publications	100% - if they appear on list of authors	Pure	Existing practice at some departments	VBN team (existing/new task)
Innovation projects	Projects	Varying to good	Pure	Existing practice at some departments	VBN team (existing task)
Referral and guidance in connection with AAU Startup Programme and project-oriented course in own startup	Referral and guidance	100%	AAU Innovation CRM-system (100%)	Existing practice	AAU Innovation (existing task)

Visibility

Traditionally, the focus has been on visibility of research in academia. This can to some extent be demonstrated by citations. There is a general wish for research to reach further and show its relevance to the outside world. ARRA (2022) talks about the recognition of technological, economic, cultural, and societal impact. The data made available for demonstration of visibility outside the research community includes press cuttings, social media metrics of publications, and "impact registrations".

Press cuttings are registered in AAU's research registration system based on a media list of Danish sources, and with a certain addition of international online sources. You can view a level termed "attention per press cutting" via the number of media in which the individual press story has been reproduced.

Any online attention that AAU's publications receive in the terms of clicks, downloads, bookmarks, comments, shares, likes, tweets, etc. is picked up and noted along with the publications. This holds for four categories: Usage, Captures, Mentions and Social Media. A measure of a department's online attention can, for example, be attributed to the number of publications - within the group of publications - that have the 10 percent most mentions in relation to the faculty.

Societal impact is in high demand but difficult to document. Under the auspices of the VBN team, an AAU system is in operation where daily press cuttings are used as possible catalysts for registration of societal impact. Approximately 15-20 press cuttings are created at AAU daily. Press cutting summaries form the basis for an assessment of whether AAU research has had an impact – great or small – outside the university. If this is the case, it is investigated whether the research and impact can be found in, and backed up by, other press cuttings, publications, projects, etc. If any such support for an impact description is detected, a description of the impact is prepared, and a registration of societal impact is made.

Submission of research results with commercial potential including inventions and software (registered in AAU Innovation's systems). AAU researchers submit inventions, software, and research results with commercial potential to ensure that knowledge produced at AAU can be of use to society. This may lead to a rise in the number of commercial technologies originating from AAU research.

Commercialization (license-, sale-, and options agreements) and/or startups and spinouts/CVR-registrations (registered in AAU Innovation's systems and departments (sideline activities)). There should be focus on crediting researchers who set up businesses, both nationally and internationally, based on knowledge originating from AAU, as well as to focus on utilizing AAU knowledge through IP-agreements, license agreements, options agreements, and CVR registrations. All of these can contribute to the display of how knowledge produced at AAU is applicable as groundbreaking solutions and hence contribute to AAU's efforts to serve as a mission-driven university.

Acknowledgement of research participation in innovation and entrepreneurship and projects for utilization purposes (registration in AAU Innovation's systems and at departments). Research containing strong innovation characteristics includes projects that not only produce new knowledge, but also transform this knowledge into practical solutions, technologies or methods with a measurable impact outside academia. It can be anything from development of new technologies, collaboration with businesses in implementation of research results to projects that address pressing societal challenges with an innovative approach. Examples could include – but not exclusively – interdisciplinary projects and programmes like:

- Open Entrepreneurship
  Open Entrepreneurship (registration in AAU Innovation's systems) is a project collaboration that ties Danish universities to the business community for the purpose of strengthening the use of academic research commercially. The initial goal is to establish a platform for turning research-based ideas into viable businesses by facilitating

collaboration across universities and involve entrepreneurs, investors, and businesses in the process. Focus is not exclusively on patentable research, but also on creating value from research projects that can be converted to actual startup cases and CVR-registered businesses. The project furthers an innovative culture in which research results are developed into new businesses with solutions that have a broad societal impact.

- Research to Business (registration in AAU Innovation's systems)
  The programme "Research to Business" is included in the indicator's data catalogue, as it supports the strategic goal of bridging the gap between research and business community. The programme provides researchers and PhD students with the necessary entrepreneurship skills to be able to transform their academic knowledge into commercial solutions, which in turn strengthens the university's socio-economic contribution.

Table 4 - Visibility

	Data	Coverage	Source + Degree of System Support	IMPLEMENTATION	Cost
Media coverage	Press cuttings	100%	Pure (100%) and Infomedia (cf. source list)	Existing practice	VBN team (existing task)
Online attention	Publications' PlumX data (excl. citations)	Varying SoMe practice	Pure	Existing practice	VBN team (existing task)
Societal impact	Impact registration (e.g. Includes minimum requirement of X number of content)	Varying use	Pure (100%) and Infomedia (cf. source list)	New practice	VBN team new task) Researchers (approval and enrichment of registration)
Reporting of research results with commercial potential	Reporting Cf. Act on Inventions	100%	AAU Innovation CRM-system and Initium (100%)	Existing practice	AAU Innovation (existing practice)
Commercializa-tion, startups, and spinouts/CVR registrations	Licence-, sales- and options agreements and setting up business	100% if AAU Innovation is involved. Varying degree of departments' registration of sideline activity agreements	AAU Innovation CRM-system and Initium (100%)	Existing practice	AAU Innovation (existing practice) AAU Departments (existing practice)

Open Entrepreneurship	Registration, concluded activities, participation and projects	100% if AAU Innovation has been involved. Varying depending on departments' registration of activities.	AAU Innovation CRM-system (100%)	Existing practice	Registration, activities held, participation and projects

Openness

Transparency regarding research results and data is one of the main points of ARRA (2022). This includes early sharing of data and results, as well as openness regarding partners. Open access to publications and data (for the latter to the extent possible) is a grant requirement of the EU. At the same time, there is an increasing demand from national funders and foundations that research publications are made openly available. Therefore, it is important that AAU researchers are aware that they may be under the obligation to make their research openly available once they have received grants. This can either be through Golden Open Access publications, where you pay an Article Processing Charge (APC), or via Green Open Access (parallel publishing) of the accepted manuscript.

The new AAU Research and Innovation Indicator represent a broad understanding of openness. Which means that all types of openness to publications and other research dissemination have value. For instance, with regards to Part B, departments can work on access to publications that do not comply with the Open Access Indicator's requirement of a maximum 12-month embargo period and limitation to journal articles. They can work towards open access to as much research as possible, even if it is only after an embargo period of e.g., 24 months.

Openness is also a matter of the individual researcher's efforts into describing his or her research profile. They can work to keep an active profile description at AAU's research portal: https://vbn.aau.dk. Creating ORCID- and Google Scholar profiles will strengthen an open online infrastructure for communication and collaboration on research.

Innovation-conducive events (registration in Pure). These are events in which public and private business partners participate and/or help organize in collaboration with AAU – e.g. workshops or seminars. Innovation-conducive events are of key importance in terms of strengthening the university's affiliation with society and further utilization of its research production. Departments that organize innovation-conducive events make a significant contribution by involving non-academic organizations in the planning and hosting of events. This type of involvement testifies to the relevance and value of AAU's research to the world outside academia. The participation of external partners, e.g. companies and public institutions, in such events contributes to the establishment of a platform for transforming research to practical usage, which in turn stimulates more innovation and supports a more innovative culture. Registration of these events in the Research – and Innovation Indicator displays and formalizes the universities' contribution to the development of society and strengthens the acknowledgement of the researcher's role as bridge builder between academic knowledge and societal needs. To include innovation-conducive events in the indicator is to acknowledge and reward researchers for stepping outside traditional research activities and engage in practice-oriented and socially relevant initiatives. This type of acknowledgement motivates greater participation in collaboration-project, strengthens

researchers' career development, and ensures that research actively contributes to innovation, societal change, and consequently European development.

Table 5 - Openness

	Data source	Coverage	Source + degree of system support	Implementation	Cost
Open Access	Publications and datasets	Varying in terms of options for green and golden OA	Pure (80%-100% cf. indicator), Data Monitor (cf. list of sources)	**Existing practice**	VBN team (existing assignment) Researchers (existing assignment with accepted manuscript)
Activities/ Memberships (mandatory for the latter)	Pure	Varying in terms of use	Pure	New practice (however, there have been registration requirements for memberships since 2021)	VBN team (New task) Researchers (new task to register these in Pure)
Active VBN profile	Pure	Varying in terms of use	Pure	New practice	Researchers (new task to register these in Pure)
Innovation-promoting events	Participation in innovation events	Varying	Pure	Existing practice	VBN (new task)

4. PERFORMANCE AGREEMENTS AND ORGANISATIONAL SUPPORT

As it appears from section three, the new indicator consists of two parts (A and B), where Part B on cooperation, visibility and openness is reported in the form of more qualitative descriptions. This section describes the thoughts on reporting collaboration, visibility, and openness, as well as how they can be placed organizationally to ensure that there is a clear framework of understanding between the different parts of the organization in relation to the distribution of tasks - particularly with regards to the connections between department and the dean's office.

4.1 PERFORMANCE AGREEMENTS

There has been a discussion in the committee regarding where to place this part of the indicator in the organization. A particular point of attention has been special consideration for the administrative task of drawing up action plans. To reduce the administrative task of the department managements, the committee recommends that the reporting inherent to Part B of the indicator is placed in the existing performance agreements between the department and the dean's office. In this way, you create a connection between the department's strategy work for the performance agreements pertaining to the AAU strategy 2022-2026 and the new indicator. Thus, the Committee proposes that reporting on cooperation, visibility and openness is incorporated into the existing performance agreements. One suggestion is that they are placed in a separate section under the heading Research. Likewise, a correlation between the AAU Research and Innovation Indicator and AAU's strategy was a key point that derived from the consultations at the academic council meetings.

As stated in section 3, it is necessary to get a performance agreement approval to get a share of the 30 percent of the indicator. The performance agreements' approval process takes place between the department and the dean's office. It is the assessment of the committee that it should be up to the faculties to define how they want the departments to describe their efforts within collaboration, visibility, and openness. However, approval must be based on an ambitious argument and several key figures extracted from Pure or from AAU Innovation’s systems. You can draw up approved limit values (local and/or shared). Thus, the departments must argue their willingness to move forward in some areas. It can be a common baseline or progression. As such, the performance agreements may contain narratives supported by statistics and other documentation regarding how the department will work with the different areas.

However, the use of the performance agreements for this part of the indicator requires that these are continued after the strategy period 2022-2026, or that the AAU Research and Innovation Indicator is incorporated into a similar document. In addition, there is a job to be done to include a help text in the present form of the performance agreements, and to clarify that it is a different pool of funds that is triggered for this part of the performance agreement.

Appendix A provides an example of how the existing performance agreements can include the AAU Research and Innovation Indicator

4.2. ORGANISATIONAL DIVISION OF RESPONSIBILITIES

The Committee proposes the following organisational division of responsibilities:

- SRFI: Responsibility for the AAU Research and Innovation Indicator
- Dean's Office: Approval of performance agreements
- Departments: Preparation of performance agreements
- VBN team Support for performance agreements statistics. Teaching and instruction in relation to publishing strategy, calculation of points, guidance regarding performance agreements based on new initiatives at national and European level. Professionally responsible for further work on - including possible development of - the AAU Research and Innovation Indicator.
- AAU Innovation: statistics support for target agreements. This material is reported in the annual department reports, which are ready in mid-June.
- Finance and accounts Department: Calculation and distribution of funds

5. DISSEMINATION AND IMPLEMENTATION

As described, it has been a goal that the new indicator provides AAU with a tool to ensure that researchers and research from AAU are in line with the international research community, where evaluation of research calls for a broader perspective with clear open science elements. For the indicator to be successful, it is necessary that it is thoroughly implemented in the organization. There must be an understanding of the motivation, elaboration, as well as the application of the indicator. A thorough implementation ensures a change in behaviour, which should lead to researchers to a greater extent incorporate new elements into the way they conduct and communicate their research. Therefore, the committee has prepared a proposal for a dissemination and implementation plan, which can be adjusted and specified further once SRFI has decided on the new indicator.

5.1. DISSEMINATION AND COMMUNICATION PLAN

As described, there is a need to communicate the new indicator at all levels of the organisation, to create a shared understanding of how it works for the individual researcher, for the department, at faculty level, and at an overall AAU level. This requires communication in both writing and speech. Therefore, the committee proposes that internal communication meetings are held in the various councils, including the departmental councils, the academic councils, and the Main Joint Consultation Committee (HSU). In addition, the committee proposes that a news item is featured in AAU Update once the indicator is eventually presented, read, and considered by the University Board. In this connection, a "Pixi" version of this report describing the indicator will be published in Danish and English.

As described initially, there is no national initiative regarding an indicator at present. Thus, AAU will feature as a pioneer university in developing such a research and innovation indicator. By constructing an indicator that contains elements from the BFI model but taking it a step further in developing it with citations, as well as open science elements, AAU's Research and Innovation Indicator could potentially be used by some or all Danish universities. The Committee believes that AAU should communicate this news externally to the other universities, to the Ministry of Higher Education and Science, to Denmark's Research Portal, etc. Therefore, work with AAU Communication must be planned in relation to how this news is best communicated *externally*. This process can begin once the SRFI has processed the AAU Research and Innovation Indicator and forwarded it to the Executive Management.

5.2 TEACHING ACTIVITIES

Dissemination and training will be an important part of the implementation of the new indicator. Due to the indicator's new format that includes both a conventional bibliometric part, with calculation of points based on publications and citations, as well as a more qualitative part regarding collaboration, visibility and openness, there is a need for the indicator to be presented widely in the organization. At the same time, there are different performance groups that have different needs in relation to introduction to and implementation of the indicator. Thus, there is a need for an onboarding process to understand the thoughts behind DORA and ARRA, and what it means in terms of research evaluation locally and internationally, e.g., in relation to JIF and publishing practices. It is important to focus on the fact that there are different ways of conducting research, and that the new indicator suggests that research should also be assessed

based on parameters other than bibliometrics with an active practice of open science. Under the auspices of the VBN team, there are already several courses that support teaching of the mechanisms of the indicator and include both conventional bibliometrics and the new parameters.

Current VBN courses

- Scholarly Communication in an Open Science Perspective (PhD course) – held twice each semester
- Boost Your Research Profile – held twice each semester
- Onboarding VBN – held twice each semester
- Open Access Publishing – held twice each semester

Regarding the courses Scholarly Communication and Boost Your Research Profile, it will require an update of the course contents to include new elements from the AAU Research and Innovation Indicator.

In addition to existing courses held during semesters, a specific course/presentation that reviews the indicator could be held at management levels 1 and 2 in the autumn of 2023. Subsequently, courses/presentations reviewing the indicator could be held for research groups/departments.

5.3 FINANCIAL IMPLEMENTATION

Following approval by SRFI, the new Research and Innovation Indicator will be incorporated as part of AAU's budget principles applicable from 2024. In the current budgetary principles, the number of BFI points is included in the distribution of basic funds. Approximately 10 percent of the total basic funds are distributed among the main areas via parameters. This model is referred to as *the results model*, or the 45, 20, 25, 10 model. In it, taximeter income from education weighs 45 percent, income from grant-funded activity 20 percent, BFI points 25 percent, and PhD degrees 10 percent.

The new indicator will replace the BFI point parameter. Before the budget principles can be finally approved by the University Board, in the first half of 2023, they must pass through a process involving the Executive Management, academic councils, and the Main Joint Consultation Committee (HSU).

The BFI parameter represents DKK 24 million in the distribution between the main areas, and test runs have shown that shifts between the main areas are minimal and are at a less significant level in the total faculty budgets. The eventual distribution principle is decided by the University Board. Within the individual main areas, there will be a different distribution between departments, but this distribution is dependent on the faculty's budget principles and the dean's management decisions.

5.4 ADMINISTRATIVE IMPLEMENTATION AND ALLOCATION OF RESOURCES

The committee agrees that the new indicator will benefit AAU and AAU's researchers by focusing on publishing and citation, while at the same time including parameters regarding collaboration, visibility, and openness. At the same time, the running-in phase involves several new tasks to

be administered and solved. Administration and quality assurance is a case in point. A task that was previously assigned to the Danish Agency for Higher Education and Science, but which in the future will be handled by the VBN team. In addition, administration and development in collaboration with Elsevier pertaining to lists of academically recognized journals and publishers, point calculation, adjustments to the model, new reporting tasks (statistics for use in performance agreements), teaching and dissemination of the AAU Research and Innovation Indicator, ongoing replies to questions from the organization about the new indicator, as well as the commissioning phase with new reporting to the budget and department and faculty managements, are also tasks that will be assigned to the VBN team as well as the Finance and Accounts Department.

It is estimated that the task can be carried out with one FTE in a project position one year – with the possibility of extension up to three years. The person will be placed in the VBN team, to which the largest part of the administrative implementation, as well as teaching and dissemination, is assigned.

5.5. TIMETABLE FOR THE IMPLEMENTATION PROCESS

Table 6 - Timetable for implementation of the AAU Research and Innovation Indicator

Tasks 2023	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Decision SRFI	5/1											
First reading Executive Management		8/2										
Hearing Academic Council & Main Joint Consultation Committee (HSU)				Mid-April								
Possible second reading by the Executive Management					17/5							
Reading The University Board						22/6						
Teaching of management and academic environments (VBN)												➔
Information via AAU Update (VBN)						Post-board meeting						
New calculations												
Communication plan – external and internal						Plan effect after board meeting						
Report in Pixi-format DK/ENG												
Quality assurance of publication points and statistics												➔

Development in collaboration with Elsevier in relation to "authority lists"												
Quality assurance of authority lists												➔

6. RECOMMENDATIONS FOR FUTURE DEVELOPMENT

1. Attention to inclusion of new digital publishing formats, including clinical guidelines, video publication, publication of datasets, protocols, etc. It will be an important part of validating these types to avoid awarding of double points.
2. The distribution between scientific publication and collaboration, visibility, and openness can be adjusted on a regular basis to reduce differences. This can be done, for example, when the organization has had time to develop the more qualitative part of the indicator.
3. Further development of calculation of FWCI. The overall data sources at department level are now based on the department's total production in Pure. A demarcation to the research areas within the departments, as defined in Scopus and SciVal, is likely to provide other perspectives on weighted citation indices.
4. In the AAU Research and Innovation Indicator, the period for calculating FWCI is set to 5 years before and up to point calculation. A further development of the indicator in relation to the FWCI may be that the period for when FWCI is calculated is adjusted, so that FWCI is calculated based on publications included in the new indicator. This means that it is not possible to expand this before the indicator has been in use for a 3-5-year period.
5. Should AAU decide to take a new step and promote its research and research contributions in other than publications, a mandatory registration of new content types in Pure e.g., grant, projects, etc. may provide a possibility.

7. CONCLUSION

The Committee's tasks and overall responsibility were to:

- Establish criteria for high-quality research that reflect current international standards and consider the different publishing patterns of the scientific disciplines
- To clarify how these criteria are implemented differently across STEM and SSH
- As far as possible, the criteria will be established within the existing overall data sources at AAU

An attempt has been made to solve the tasks by developing an indicator with two parts: A bibliometric (Part A) and a qualitative part (Part B) with information, including statistics, broadly based on the results of innovation and collaboration, visibility, and openness in research practice. While the bibliometric part is neutral in terms of scientific disciplines and directly supports the university's internal distribution of basic funding for research and innovation, Part B may be is useful in the design and follow-up on more subject-specific research- and innovation strategies at department level.

The bibliometric part consists of a measurement of scientific publishing, which is modified with a citation indicator to the same extent that it is possible and relevant within the discipline. Thus, the model will not only inspire productivity but also inspire to conduct research that can be published in esteemed journals and gain international attention and importance. The model includes all scientific publication types throughout the spectrum, as well as it accommodates Danish-language publication. It is supported by international research and with simulations that show that it will balance between the scientific disciplines. Instead of criteria that are implemented differently on STEM and SSH, the model uses criteria that, considering relevance and validity, are given unequal weight based on where in the scientific spectrum the research has been conducted. The report clarifies how it operates in the scientific spectrum. The advantage of a common bibliometric model is that it does not distinguish between research that may take place within the same department or faculty.

The statistical part expands and provides the indicator with a more holistic and nuanced basis for assessing and promoting sound research- and innovation practice. This part reflects recommendations from the EU, Science Europe, the European University Association, and DORA, to document research not only using metrics based on scientific publishing, but also by means of indicators and qualitative information on innovation, open science practice, internal and external collaboration, and visibility in society.

Both Parts A and B can be supported by AAU’s own data. The individual researcher will not be burdened by more registration, but the central capacity will have to be expanded to some extent to ensure implementation and full utilization of the opportunities offered by the new AAU Research and Innovation Indicator.

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APPENDIX A: EXAMPLE OF PERFORMANCE AGREEMENT