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RESEARCH ARTICLE

Research Classification using the Malaysian Research and Development Classification System (MRDCS)

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ABSTRACT

Classifying research projects or research publication into research areas is crucial in many statistical analyses including for example in bibliometric analysis. Research publication classification usually takes place at the level of journals, where subject categories based on available databases like the Web of Science or SciVal are some of the popular classification systems. However, journal-level classification systems have limitation especially when classifying multidisciplinary journals. To overcome this limitation, it is suggested that a classification system that can classify research be constructed based on the areas of research proposals and their related publications. Successful grant applications/research projects and their publications were clustered into research areas based on the Malaysian Research and Development Classification System (MRDCS) (6th Edition). A total of 1738 research projects managed by Universiti Malaya's Research Cluster from year 2015 to 2017 were mapped. The strengths and the limitations of the proposed classification system are also discussed. Results indicate that out of the 20 research categories, Medical and Health Sciences, Social Sciences, Economics, Business and Management, Humanities, and Engineering and Technology emerge as the top five research categories with the highest critical mass value based on the number of projects. Classification mapping also found Engineering and Technology, Medical and Health Sciences, Material Sciences, Social Sciences, and Applied Sciences and Technologies to be the top five research categories that produced the highest number of outputs in terms of publications.

Keywords: Research grant mapping; Classification system; Research University; Research management

1. Introduction

In any bibliometric or scientometric research related to research outputs, a classification system is an essential tool to assigns journals or individual publications based on its research areas. Such systems can be used to simplify and assist in literature search, to expand the analysis to the structure of research disciplines, or even to facilitate bibliometric research evaluation. Various methods and identification system are being used to catalogue and classify the research areas. This paper explores several types of classifications and methods on how research or niche areas of projects and publications can be identified. The three major methods are: the Thomson Reuters' Web of Science databases, SciVal and the Malaysian Research and Development Classification System (MRDCS). By understanding the 'rules' underlying each of the methods, existing datasets are matched to ensure that the chosen classification system will cover all the subject areas of the projects.

According to Reindert et al. (2010), a research area should be able to show basic and noticeable level of activity, which are measurable in terms of the number of publications. The research areas of surveyed publications can be identified through their electronic bibliographies, supplemented by additional research classification information. (Fuchs et al., 2011). Vertakova et al. (2016) presented the methodological guidelines for carrying out morphological analysis and synthesis of research where one of the aims was to identify the formation of new areas in ongoing research. The analytical calculation results can then propose the new areas and themes of the research studies.

The most popular classification system for bibliometric and scientometric research is the system currently in use by Thomson Reuters' Web of Science database (Waltman & Eck, 2012). There are about 250 research area/ subject categories in this system. The Web of Science covers scholarly books, journals and conference proceeding based on evaluation impact (Wáng et al., 2014). A somewhat similar system to Web of Science is the Elsevier's Scopus database where both classification systems work at the level of scientific journals (Waltman & Eck, 2012). Within these systems, journals are categorized with one or more research areas. Although individual articles lack direct research area tags, the assignment of research area(s) to each publication is determined by the journal responsible for its publication. Hence, classification systems based on journals have demonstrated limitations in providing detailed information, particularly when dealing with multidisciplinary journals. (Waltman & Eck, 2012).

Another tool is SciVal which assists evaluation and comparison of research based on data from Scopus, the world's largest abstract and citation database for peer reviewed publications. It consists of three integrated modules; overview, benchmarking and collaboration. Scopus utilizes All Science Journal Classifications (ASJC) codes to systematically classify and categorize published research based on its subject area. Serial titles undergo classification within the ASJC scheme by in-house experts at the initiation of Scopus coverage. This categorization relies on the aims and scope of the title, as well as the content it disseminates. The ASJC system further organizes research into 4 overarching subject areas encompassing 30 specific subject area classifications. This can, for example, be an institution's strategic priority to demonstrate areas of research strengths and identification of emerging areas of science or any other topic of interest. For each specified research area, SciVal furnishes comprehensive information on the institution's involvement, encompassing the number of publications and citations. Additionally, it offers an overview of the top-contributing institutions at regional, national, and global levels, facilitates

benchmarking against other institutions, and identifies existing and potential research collaboration partners (Elsevier, 2014). The major advantage that SciVal has over other metrics and reporting tools is the high volume of data. SciVal uses supercomputer technology to process more than 32 million publication records from almost 22,000 journals from 5,000 publishers across the globe, mostly from the Scopus database (Dresbeck, 2015). However, since the data is mainly extracted from the Scopus database, SciVal will not be able to provide a comprehensive situational analysis, especially in the fields of arts, humanities some social sciences. The attention of research often focuses on the output especially the classification system at the journal level such as via Web of Science and Scopus. Classification systems at the journal level normally consists of at most a few hundred research areas, and they often face difficulties in dealing with multidisciplinary journals such as *Nature (https://www.nature.com/)* and *Science (https://www.science.org/journal/science)*. There is a need to use a combination of bibliometric tools for a better classification system.

Yet another tool is the Malaysian Research and Development Classification System, better known as MRDCS, is a classification system tool of that was designed for classifying and describing research activities in Malaysia to the highest detail and accuracy (MASTIC, 2012). MRDCS was first introduced in the 1992 National Survey of Research and Development and published by the Malaysian Science and Technology Information Centre (MASTIC), Ministry of Science, Technology and Innovation (MOSTI) in 1993. To date, the ministry has published six editions of the MRDCS. These updates are to keep up with the explosion of technological advances, changes in national economic policies and science, key focus areas in technology and innovation (ST&I), hence resulting in a more dynamic classification of research areas while addressing emerging research areas. The classification of research activities is anticipated to establish the foundational framework for measuring and analysing research and development (R&D) endeavours in Malaysia. It aims to serve as a valuable indicator for the direction of future R&D efforts, ultimately benefiting all stakeholders, including researchers, decision-makers, and the public.

The present study will use MRDCS to conduct a preliminary analysis based on its broad areas which will be matched with available datasets to construct a theoretical framework for a method used for visualisation purposes. MRDCS will be used as it is a tool that has been designed primarily to meet the needs in classifying research activities in a more consistent and structured manner which are relevant in the Malaysian context.

In comparison to earlier classification systems of research areas, the method introduced in this study has several advantages. Firstly, the method works at the level of individual research grant applications and related outputs in terms of publications rather than classification at the journal level. This allows for a more detailed classification of research areas without facing difficulties when classifying multidisciplinary journal. The classification method is also more transparent and relatively simple with minimal researcher engagement involved. MRDCS (6th edition) is described in detail (https://mastic.mosti.gov.my/mrdcs/v6). Anyone with enough data access and computing resources should be able to replicate the steps taken during the classification of research output using this tool.

2. Research Clusters at Universiti Malaya (UM)

Research activities in University of Malaya (UM) are managed and governed by the Institute of Research

Management and Services, or its Malay acronym, IPPP. Previously known as the Research & Development Unit (R&D Unit), IPPP was established in October 2000 as part of UM's aspiration to become a premier research university in Malaysia. IPPP acts as a central coordinator for all research activities as well as a 'one-stop' centre for all research information for the university.

Prior to being accorded the Research University (RU) status on October 11, 2006, research that was carried out in UM as loosely clustered according to various disciplines at the faculty level. Upon being granted RU status and cognizant of the objectives of the establishment of RUs, there was an urgency to redefine research clusters to be more focused to champion more efficient research strategic planning and the mobilisation of various research groups and units. Research clusters are not centres of excellence (CoE) but defined as "broad-based thematic areas of research" that act as umbrellas to support CoE (Research Cluster Office, 2023). The research clusters are instrumental in directing the university's research activities and assisting in galvanizing university research activities now and in the future. This is because the research clusters provide a broad direction for developing the university's research agenda. Each cluster incorporates interdisciplinary approaches and coordinates research activities from different disciplines. Since its inception in 2009, the research clusters have transitioned to the following (see Figure 1):

i) Innovative Industry & Sustainability Science
ii) Frontiers of the Natural World
iii) Health & Well-Being
iv) Social Advancement & Happiness

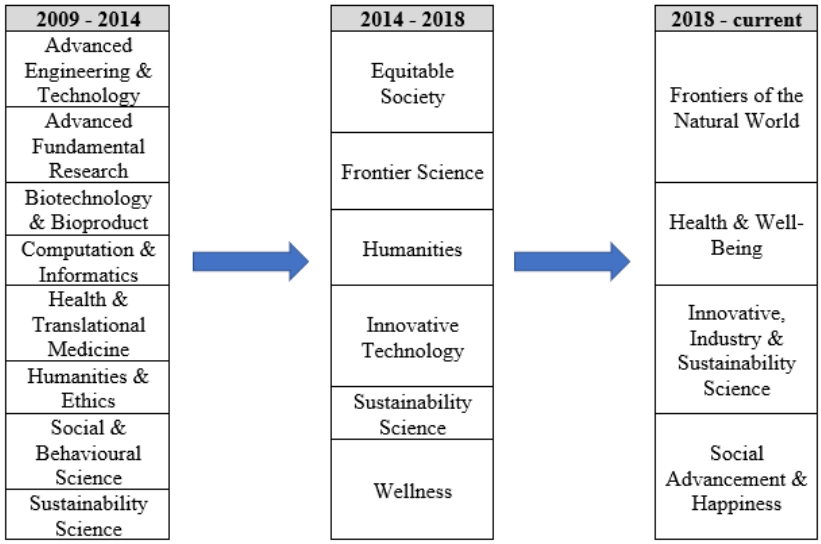

Figure 1: Transition of Research Clusters 2009 – 2023.

3. Methodology

MRDCS

MRDCS classifications provide the basis for the measurement and analysis of R&D activities and statistics that are useful guidelines to government policy makers, industrialists and researchers. Additionally, they

function as a useful indicator for discerning the direction of R&D and technological change. As technological advances become increasingly dynamic, there are no limitations to the introduction of new researchable areas. The 7th edition of MRDCS is a continuation and contains latest updates to address technological gaps and barriers. The established standard framework in these classifications enables efficient prioritization, funding allocation, and maximization of national R&D efforts. Additionally, it serves as a clear indicator for international comparisons.

The proposed method for constructing research grant applications and its publication-level classification system of research areas using MRCDS can be divided into three steps:

Step 1: Determining the related research grant applications and their publications.
Step 2: Clustering research grant applications and their publications into research areas.
Step 3: Labelling research areas.

Step 1: Determining the related research grant applications and its publications

Firstly, each research cluster sorted the UM Research Grant (UMRG) applications according to the year of application. The identified year of research grant application for this study was from 2015 to 2017. The number of publications for each research project was also recorded. This sorting process can be done via the online Research Project Management System (RGMS) developed by UM Centre for Information Technology. Between the years 2015 and 2017, there were a total of 1738 research grant applications and 2457 publications were identified as having fulfilled the criteria for classification.

Step 2: Clustering research grant applications and its publications into research areas

The Field of Research (FoR) represents R&D activities classified according to their scientific and academic disciplines. These disciplines tend to be universally applicable, with national variations arising from the grouping of different research fields. The MRDCS follows a hierarchical structure, with codes F representing the Field of Research (FoR) and codes S representing the Socio-Economic Objective (SEO). The descending characters in the MRDCS, following codes F and S, identify its Division, Category, Group, and Area. The broader the subject area or research discipline, the higher the hierarchy. Specific sub-codes are assigned within the FoR classifications hierarchy to illustrate hierarchical differences. This classification enables the categorization of R&D activities based on the field of research, focusing on the nature and methodology rather than the activity or purpose of the performing unit.

The FoR classification consists of discrete categories which identify research fields through various disciplines and major subfields investigated by universities, national research institutions and related tertiary institutions, organisations and emerging areas of study. It reflects the expansion of research activity from the former 2 division- to the present 9 division-classification unit. The inclusion of new research areas is inevitable with the accelerated pace of the country's R&D. The latest edition classified all the R&D activities into 9 Divisions, 20 Categories, 271 Groups and 3297 discrete Areas.

The FoR has four hierarchical levels, starting at the Division (broadest level), Category, Group and Area (finest level where research project is allocated). Each level is identified with a unique number or code for easy reference. The figure below shows the approach to the FoR hierarchical structure;

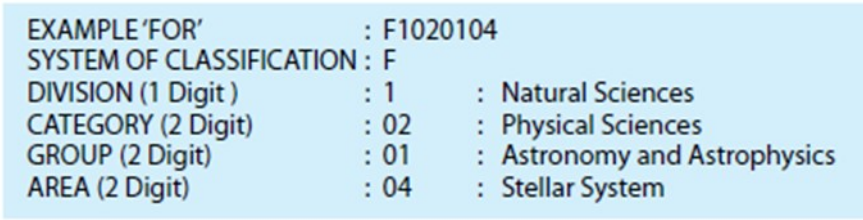

Figure 2: Example of the FoR Hierarchical Structure.

The methodology provides a classification system in a hierarchical structure that can be utilised to cluster research grant applications and publications into various available research areas and the research areas are then automatically organized into the higher hierarchical structure.

Step 3: Labelling research areas

There are 9 possible Divisions which represent broad subject areas or research disciplines, while Categories, Groups and Areas at the lowest level representing more detailed dissections of the categories which allow the entry of more possible areas for future expansion. The Division level was first be identified and labelled and this then progressed to the lower level of the hierarchy (Category, Group and Area). These labels were identified and obtained by extracting the keywords or terms from the titles or abstracts of the research grant proposals and its publications. A single keyword or term is usually not enough to indicate the research division clearly. Thus, labels for each research division following a set of terms can be used:

i) Identification of terms in titles and abstracts of publications

At this stage, all keywords or terms occurring in the titles, abstracts from the research grant applications and its publications were identified.

ii) Selection of the most relevant terms

The most relevant keywords or terms to the respective research divisions (highest level of the classification system) were selected and applied. Up to five relevant keywords or terms for each research division could be selected. The description of the steps of the proposed methodology was now complete.

4. Results and Discussion

There are four levels in this classification system. The highest level (i.e., level 1 – Research Division) of the classification system was studied, followed by the upper-mid. level (i.e., level 2 – Research Category), then the lower-mid level (i.e., level 3 – Research Group) and finally the lowest level (i.e., level 4 – Research Area). Of the 1738 research grant applications and 2457 publications which researchers applied into the classification system, only one (1) research grant application could not be included in the system.

During the process of labelling the research area, the following notation was used to label the research divisions in MRCDS:

- Research Division z: A research area at level 1 of the system.

- Research Category y.z: A research area at level 2 of the system which is one of the sub-areas of area z (level 1).
- Research Group x.y.z: A research area at level 3 of the system which is one of the sub-areas of area y (level 2).
- Research Area w.x.y.z: A research area at level 4 of the system which is one of the sub-areas of area x (level 3).

Level 1

At level 1, the classification system consists of 9 divisions. Figure shows the distribution of research grant application and its publication over these divisions. The average number of research grant applications and their publication per division was approximately 193 and 273, respectively. The largest division included 357 research grant applications with 709 publications, while the smallest research area covered only 19 research grant applications and 35 publications.

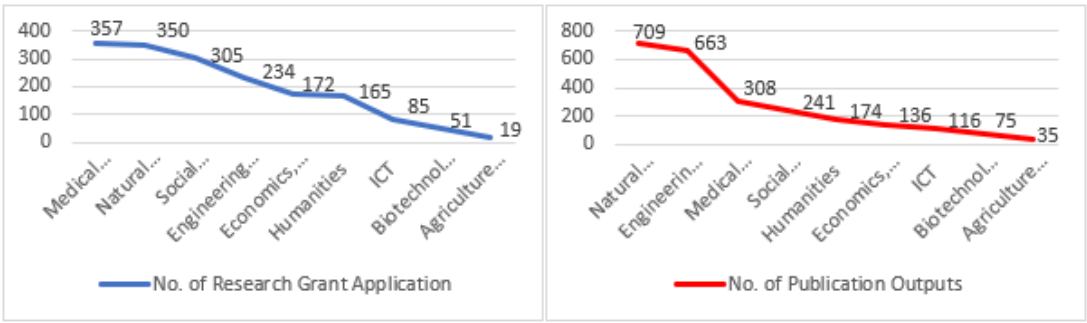

Figure 3: Distribution of research grant applications and their publications over the 9 research divisions at level 1 of MRDCS.

To label the 9 research divisions at level 1 of MRDCS, suitable keywords or terms for the research areas were manually identified and obtained. One main concern raised is that there were research areas that corresponded closely with well-known broad scientific disciplines such as science, social sciences, computer science, engineering, and education. Interestingly only a partial correspondence was found between MRDCS research areas and these traditional disciplines. This result indicates that traditional disciplines (e.g., science, social sciences, computer science, engineering, education) may not reflect UM's actual scientific research at the point that this study was carried out.

The lack of correspondence between the research divisions in MRCDS and traditional scientific disciplines created a difficulty for labelling the research divisions. For instance, no clear distinction between disciplines such as science and technology, law, Islamic studies, material science, and astronomy was found based on MRCDS research divisions. Therefore, the labelling was further refined to the research areas at level 2 or the upper-mid level of MRCDS, namely the research category. Table 1 lists the distribution of research grant applications and their publications over the 9 research divisions at level 1 of the MRDCS.

Table 1: Distribution of research grant application and its publications over the 9 research divisions at level 1 of the MRDCS.

Distribution of research grant application			Distribution of its publications		
Division	**Name of Division**	**Percentage**	**Division**	**Name of Division**	**Percentage**
5	Medical and Health Sciences	20.6%	1	Natural Sciences	28.9%
1	Natural Sciences	20.1%	3	Engineering and Technology	27.0%
7	Social Sciences	17.6%	5	Medical and Health Sciences	12.5%
3	Engineering and Technology	13.5%	7	Social Sciences	9.8%
9	Economics, Business and Management	9.9%	8	Humanities	7.1%
8	Humanities	9.5%	9	Economics, Business and Management	5.5%
4	ICT	4.9%	4	ICT	4.7%
2	Biotechnology	2.9%	2	Biotechnology	3.1%
6	Agriculture and Forestry	1.1%	6	Agriculture and Forestry	1.4%

Level 2

Level 2 of MRDCS consists of 20 research categories. The average number of UMRG research grant applications and their publications per category was approximately 86 and 122, respectively. The largest category included 357 research grant applications and 485 publications, while the smallest research category covered only one research grant application with no publication output.

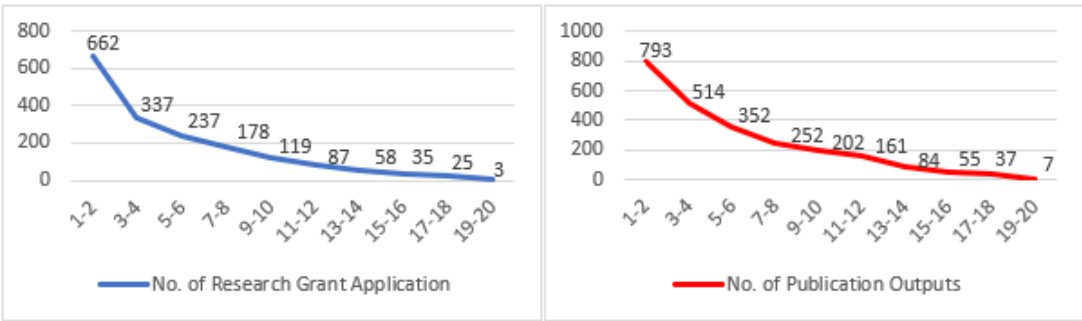

Figure 4: Distribution of UMRG research grant applications and their publications over the 20 research categories at level 2 of MRDCS.

Figure 5 shows the mapping of 1738 UMRG research grant applications and 2457 publications at both levels 1 and 2 of the MRCDS classification system. The research areas have been grouped into nine divisions represented by circles with different colours. Each division corresponds with one or more research categories at level 2 of MRCDS classification system. The size of the circles indicated the critical mass or the number of research grant applications in each research category.

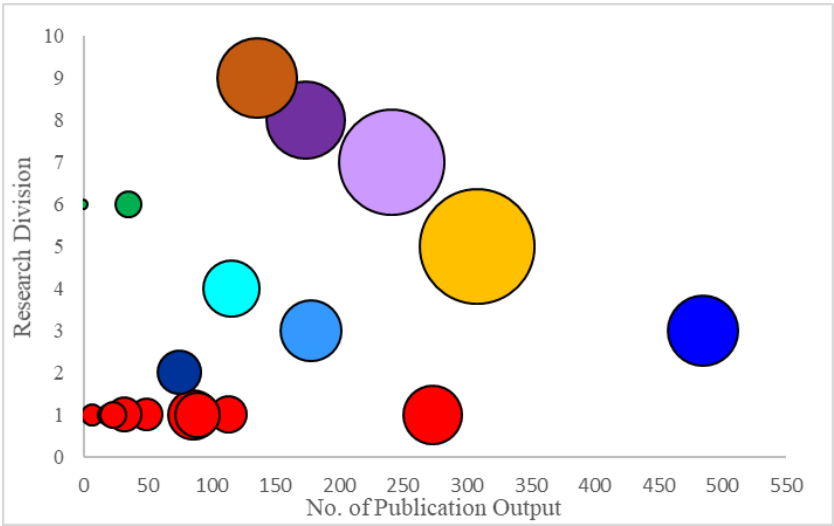

Figure 5: Mapping of the 1738 UMRG research grant applications and 2457 publications at both levels 1 and 2 of MRCDS classification system.

It was found that the top three producing research divisions in terms of publications and their research category were Natural Sciences, Engineering & Technology and Agriculture & Forestry (see Table 2). The keywords from the research grant applications and publications of research division 1 (Natural Sciences) reflected research mostly from the categories of Nuclear Sciences, Physical Sciences and Material Sciences. While keywords labelled under research division 3 (Engineering & Technology) and 6 (Agriculture & Forestry) also reflected research under their respective categories.

Table 2: Top three producing research divisions in terms of publications and their research categories.

Research Division	No. of grant application (a)	No. of publications (b)	(a):(b)	Research category
1 (Natural Sciences)	350	709	1:2.03	Nuclear Sciences (1:17.00); Physical Sciences (1:3.14); Material Sciences (1:2.94)
3 (Engineering & Technology)	234	663	1:2.83	Engineering and Technology (1:3.62)
6 (Agriculture & Forestry)	19	35	1:1.84	Agricultural Sciences and Technology (1:2.06)

Level 3 and Level 4

The UMRG research grant applications and publications can be additionally grouped into research groups and research areas, corresponding to levels 3 and 4 in the MRDCS classification system. It's noteworthy that, at present, the research cluster office has not undertaken this clustering based on expert opinion. The identification of the most pertinent keywords or terms for clustering grant applications and their publications at levels 3 and 4 needs to be conducted with expert input. Therefore, collaboration with experts possessing a broad understanding of the scientific literature in specific disciplines is crucial for advancing the clustering processes. This undertaking also mandates further data collection to establish a comprehensive database of pertinent keywords or terms before initiating the clustering of UMRG research grant applications and publications at levels 3 and 4 of the MRDCS classification system.

5. Conclusion

This paper discussed the utilisation of the MRCDS (6^{th} edition) classification system to group or cluster research grant applications and their publications. Each grant application and publication are assigned to a research division, then their research category, research group and lastly research area that are all organized in a hierarchical structure. At the highest level, research divisions may, for instance, correspond with broad research disciplines. At the lowest level, it corresponds to a specific research area.

In line of the underlying aim of research to discover new knowledge and inform action, the classification of research can shed light on key and emerging research areas. It can also assist in contextualizing research findings within a larger body of research. Apart from that, the findings can facilitate decision-making regarding the relative worth or potential impact of the research areas and develop new niche areas, and thus, the information derived can be used for strategic planning for research areas. In addition, the results could be used to justify potential areas for policy development and future project implementation.

In this paper, a clustering of 1738 UMRG research grant applications and 2457 publications were carried out up to research categories (level 2) where an average of 86 of UMRG research grant applications and 122 publications were clustered per category. However, further clustering requires a more comprehensive database of relevant keywords or terms which has to obtained from experts with a broad overview of the scientific literature in specific disciplines. Despite the limitations of this study, the results indicates that the MRCDS classification system is a suitable method to classify research grant applications and their publications. Hence, future studies should focus on creating the comprehensive database of keywords to cluster future research grant applications and its publications into specific research areas.

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References:

Buter, R.K., Noyons, E.C.M., & van Raan, A.F.J. (2010). Identification of converging research areas using publication and citation data. *Research Evaluation*, *1*(1), 19-27. https://doi.org/10.3152/095820210X492503

Dresbeck, R. (2015). SciVal. *Journal of the Medical Library Association*, 3(3): 164–166.

Elsevier. (2014). Scival user guide. Retrieved from https://www.acu.edu.au/__data/assets/pdf_file/0007/622654/SciVal_user_guide.pdf

Fuchs, L., Pernul, G., & Sandhu, R. (2011). Roles in information security – A survey and classification of the research area. *Computers & Security*, *30*, 748-769.

MASTIC. (2012). Malaysian Research and Development Classification System (6th Edition). Malaysian Science and Technology Information Centre (MASTIC). Retrieved from https://mastic.mosti.gov.my/mrdcs/v6/code

Research Cluster Office. (2023). *About Us*. Research Cluster Office. Retrieved https://researchcluster.um.edu.my/about-us

Vertakova, Y., Klevtsova, M., & Babich, T. (2016). Identification of the new research areas and development of the existing ones by methods of morphological analysis and synthesis. *Economic Annals*-XXI, *157*(3-4(1)), 4-7. http://dx.doi.org/10.21003/ea.V157-0001

Waltman, L., & Eck, N.J.V. (2012). A new methodology for constructing a publication-level classification system of science. *Journal of the Association for Information Science and Technology*, *63*(12), 2378-2392. https://doi.org/10.1002/asi.22748

Wáng, Y.J., Arora R., Choi Y., Chung H., Egorov V.I., Frahm J., Kudo, H., Kuyumcu, S., Laurent, S., Loffroy, R., Maurea, S., Morcos, S.k., Ni, Y., Oei, E.H.G., Sabarudin, A., & Yu X. (2014). Implications of Web of Science journal impact factor for scientific output evaluation in 16 institutions and investigators' opinion. *Quantitative Imaging in Medicine Surgery*, *4*(6), 453-461. https://doi.org/10.3978/j.issn.2223-4292.2014.11.16