Data-Informed Decision Making for Internationalization Strategies Using a Descriptive Dashboard

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Abstract: This paper presents a data-driven approach to enhancing the internationalization efforts at Universiti Sains Malaysia (USM), through the development of a descriptive Power BI dashboard that displays all relevant key metrics. The dashboard addresses the institution's challenges in measuring the impact of internationalization initiatives due to dispersed data sources by consolidating data on full-time international students, student mobility, and international partnerships into a single point. It reveals patterns in student enrollment, mobility, and partnership dynamics that support informed decision-making and optimized resource allocation, leading to more sustainable and effective internationalization strategies.

Ongoing work focuses on evaluating the impact of the dashboard on business operations to ensure long-term sustainability in USM's international engagements. This project demonstrates the role of data analytics in driving sustainable decision-making within higher education and reducing the ecological footprint by centralizing data access and minimizing resource use.

Keywords: Internationalization, Higher Education Institution, Sustainable Development, Dashboard, Data Analytics, Resource Efficiency.

1 Introduction

Internationalization in higher education is widely recognized as adding a global or intercultural element into its processes [1]. It encompasses a diverse range of activities, from student mobility programs and collaborative projects with foreign institutions to on-campus events that promote cultural awareness among students. The benefits of internationalization for universities are manifold, including the enrichment of learners' experiences, the establishment of international networks, and supporting financial sustainability through international student enrollment.

Universiti Sains Malaysia (USM) stands as one of Malaysia's premier universities, boasting significant student numbers and substantial research output. The institution has long been actively engaged in internationalization efforts, even participating in

initiatives such as the Marco Polo project, which aimed to modernize international relations offices to foster cooperation among universities in Southeast Asia [2] and promote sustainable global engagement. USM has also programs like USM International (USMi), KAWAN, and USM Student Buddies [3] that are currently active and build connections among local and international students, presenting a healthy view of cultural exchange.

The International Mobility and Collaboration Centre (IMCC), which serves as USM's international office and is responsible for developing and implementing the university's internationalization strategies, has difficulty quantifying the outcomes of internationalization strategies, despite the previously mentioned engagements. Relevant data sources are dispersed across different departments within the institution and lack integration at the IMCC. To address this gap, the current project consolidates key data on internationalization—full-time international students, mobility, and partnerships—into a Power BI dashboard that promotes sustainable practices by optimizing data accessibility and reducing redundant resource usage. This centralized approach minimizes the environmental impact of resource-intensive data management processes and supports informed decision-making, enabling USM to prioritize impactful and sustainable partnerships. Through complete documentation and user-friendly design, the dashboard ensures long-term functionality, aligning with USM's commitment to sustainable internationalization in higher education.

2 Literature Review

2.1 On Internationalization

De Wit and Altbach [4] highlight that higher education institutions are increasingly prioritizing internationalization strategies. These strategies are enacted to enhance educational quality, research, and societal benefits. Internationalization efforts can be reflected in partnerships, which are signed contracts that focus on joint research, student and staff exchanges, and collaborative curriculum development to achieve positive impact.

Lauring and Selmar [5] asserted that cultural diversity on campus boosts satisfaction for both students and staff, supporting the broader goals of internationalization. A globally diverse community draws individuals seeking multicultural experiences, while the presence of international students from distant regions serves as a clear indicator of successful internationalization efforts.

Assessing universities' internationalization endeavors also involves various other metrics, including the engagement of foreign academic staff in curriculum development, organization of international conferences and seminars, and participation in global funding initiatives [6]. Additionally, academic mobility and the export of education should also be considered. However, challenges such as inadequate strategic planning for mobility, such as insufficient accommodation for foreign students and inadequate language training for outbound students, can impede

progress. For effective strategizing, there must be comprehensive insights into the current internationalization landscape.

2.2 Dashboards in Business Intelligence Applications

A dashboard is a collection of business-critical visualizations displayed on a single screen. Dynamic dashboards have emerged as a pivotal tool in modern data analytics, offering real-time data updates and interactive features that empower users to derive insights efficiently[7]. By seamlessly integrating with databases, these dashboards provide timely information, enabling informed decision-making processes. Their flexibility allows users to explore data at various levels of granularity, from overarching metrics for Key Performance Indicators (KPIs) to specific details, facilitating a deeper understanding of trends and patterns[8]. Furthermore, the remote accessibility of dynamic dashboards fosters collaboration among stakeholders, regardless of their geographical locations, enhancing organizational agility and competitiveness in today's fast-paced business landscape.

At USM, there has been a move towards monitoring dashboards in recent years. An example is an alumni tracking system that was developed to provide insights into the post-graduation performance and activities of USM graduates [9]. The alumni project used Power BI to create a user-friendly dashboard that enables stakeholders to access and interpret data effectively. It serves as a central repository for relevant information, allowing university administrators to make informed decisions and assess the effectiveness of various initiatives.

3 Methodology

3.1 Data

Full-time International Student Data: Full-time international student data is sourced from the Institute of Postgraduate Studies (IPS) at USM. It comprises records of active full-time international students for each semester, with the first semester dating back to 2017.

Student Mobility Data: Student mobility data is categorized into inbound and outbound movements. Outbound mobility pertains to USM students engaging in programs outside Malaysia, while inbound mobility refers to international students coming to USM from foreign universities[10]. IMCC staff record data for both inbound and outbound mobility locally, while outbound mobility is also tracked by bHEPA (Student Development and Alumni Affairs Division) at USM. A standardized template has been established to unify future data representations between the two organizations.

Partnership data: Partnership data is accessible through the Industry-Community Network Information System (ICN-IS) interface[11], a comprehensive database managing industry and community engagement data across USM departments. Partnership records are stored by year, and across year data analysis is not supported.

Furthermore, it is time consuming to access, and the database experiences technical difficulties frequently.

3.2 Data Preprocessing

Data preprocessing was carried out using Python scripts and the Power BI Query Editor [12], to ensure the quality and consistency of the data. This stage included, but was not limited to, the following steps:

- Translation of Country Names: Country names were translated from Malay to English to ensure standardization across all data sources and facilitate visualization in Power BI.
- Mapping to Regions: Country names were mapped to regions, and a new attribute for regions was added to enable geographical analysis of the data.
- Integration of Outbound Mobility Data: IMCC and bHEPA outbound mobility data were combined, and duplicate data points were removed to ensure data integrity.
- Handling Missing Values: Rows containing missing values in attributes crucial for visual analysis were dropped across all datasets.

Finally, the processed data was stored in Supabase, an open-source database platform that utilizes PostgreSQL as its underlying engine, which serves as the backend for this dashboard project.

3.3 Data Visualization

Data visualization was conducted exclusively using Power BI Desktop. The process involved connecting the Power BI report to the database and crafting the dashboard design. Extensive consultations were held with stakeholders at the IMCC to ensure that the dashboard design met their requirements and aligned with the IMCC's business objectives. Then the dashboard was published to Power BI Service, an online software-as-a-service platform, which allowed for remote access and sharing with all relevant parties [13]. The Power BI dashboard will be automatically updated whenever the data sources in the database are refreshed.

3.4 Deployment

To address the issue of data dispersion and that some of the data sources cannot be directly connected to the Power BI dashboard, an interface was developed. The interface, which was built using Streamlit, a Python library for creating front-end applications [14], features dedicated sections for each data source so that all the relevant data sources can be uploaded through it. It also performs the data processing necessary before appending the new data to the database, after which the dashboard is updated . Through the interface, users can upload new data, override existing data, and download the current processed data file from each respective source, ensuring ease of use and maintenance of the project.

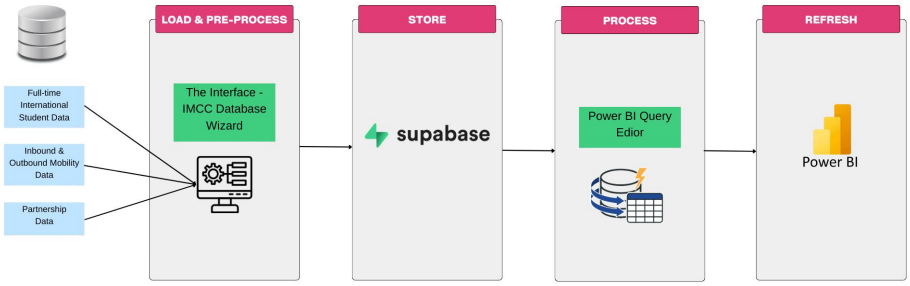

Fig. 1. The deployment process.

Figure 1 outlines the deployment process triggered whenever new data is uploaded to the interface. This process ensures seamless integration of the updated data, maintaining the accuracy and relevance of the information for analysis and visualization. The interface guarantees easy access to a unified data source, reducing the energy costs required to access the dispersed data sources previously and the frustrations due to frequent glitches faced using the old data systems.

4 Results

The final dashboard contains 12 pages in total, an overview and trends for each of the four data sources (full-time international students, inbound mobility, outbound mobility, and partnerships), and a section for fine grained analysis as well.

4.1 Full-time Students:

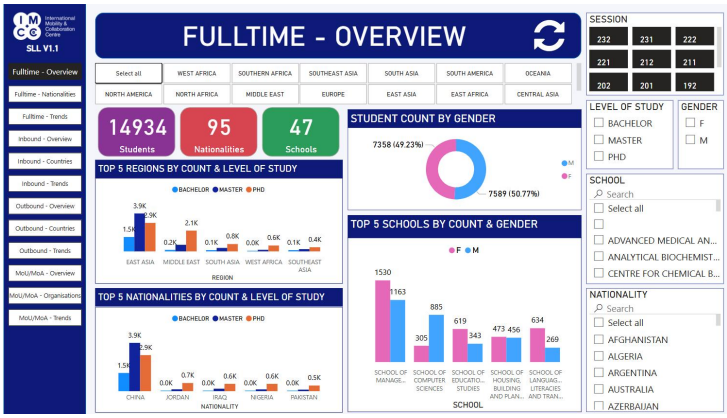

Fig. 2. Full-time international students overview

Between the years 2017 and 2024, USM hosted a total of 14,934 full-time international students. Notably, the largest portion of international students originated from China, with Jordan ranking second, albeit with a noticeable discrepancy, as illustrated in Figure 2. Furthermore, analysis revealed that the School of Management

accommodated the highest number of international students, followed closely by the School of Computer Science.

These findings not only shed light on the geographical and disciplinary preferences of international students but also provide valuable insights for strategic positioning of schools within the university. USM can refine its approach to attracting and accommodating a more diverse international student body by identifying successful strategies employed by favored schools and discerning the scientific subjects preferred by international students.

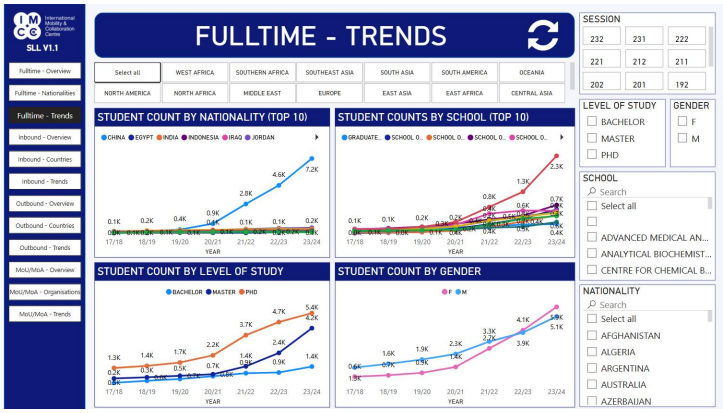

Fig. 3. Full-time international student trends

While there has been a consistent increase in the enrollment of students from various countries over the years, there was a remarkable surge in the number of Chinese students, skyrocketing from 376 in 2019/2020 to 7199 in 2023/2024, displayed in Figure 3. Interestingly, the data also revealed a significant disparity between postgraduate and undergraduate international student numbers. Nearly eight times as many postgraduate students were enrolled as undergraduates, indicating a preference among international students for pursuing higher degrees at USM. This trend may reflect several factors, including a more accessible admission process for postgraduates and USM's reputation as a research hub with commendable research output. These findings illustrate USM's attractiveness as a destination for advanced studies and research opportunities.

4.2 Student Mobility:

Inbound Mobility:

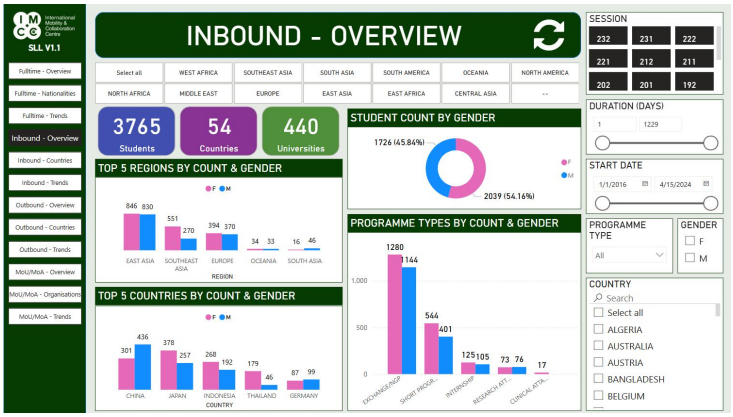

Fig. 4. Inbound mobility overview

During the specified period, Universiti Sains Malaysia (USM) hosted a total of 3,765 students from 54 countries. China consistently ranked as the top source country for inbound mobility students, maintaining its position from 2016 to the first quarter of 2024, with Japan following closely behind. Interestingly, Germany represented the sole non-Asian country within the top five spots. There are different types of student mobility, and they are illustrated in the 'Programme Types by Count & Gender' graph in figure 4. Exchange programs, which fall under credit mobility, emerged as the predominant category.

Outbound Mobility:

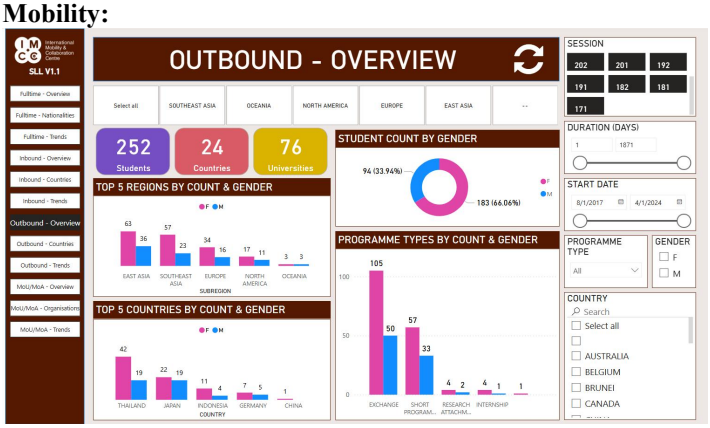

Fig. 5. Outbound mobility overview

Outbound mobility presents a less robust picture compared to inbound mobility, primarily due to the considerable expenses associated with international travel for local students and the lack of sufficient funding [3]. While there have been 3,765 inbound students recorded since 2017, as depicted in Figure 4, the number of outbound students is considerably lower, totaling only 252, as shown in Figure 5.

4.3 Partnerships

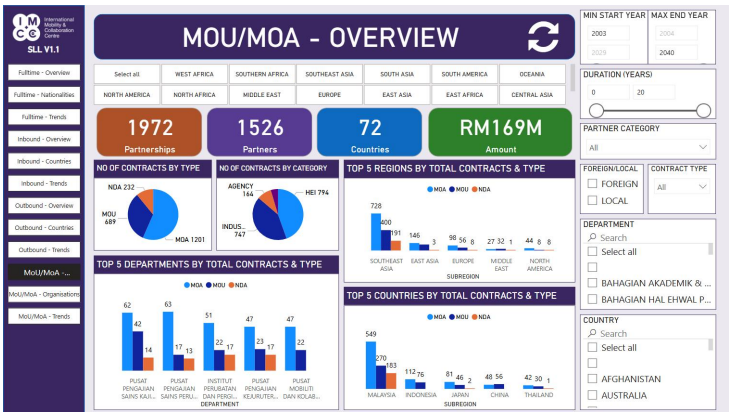

Fig. 6. Partnership overview

Since 2003, USM has established a total of 1,972 partnerships with 1,526 partners. A single partner can engage in many simultaneous partnerships. As seen in Figure 6., Southeast Asia emerges as the leading region in terms of partnerships, closely followed by East Asia, which aligns with these regions' geographical proximity to USM. Among the types of partnerships, Memorandums of Understanding (MoUs) are the most prevalent, indicating their significance as the most binding agreement among the three types. The analysis also reveals that higher education institutes represent the primary category of partners, closely followed by industry partners. While this diversity signifies USM's extensive network across various sectors, there's an opportunity for further diversification efforts to broaden the network with partners from other regions.

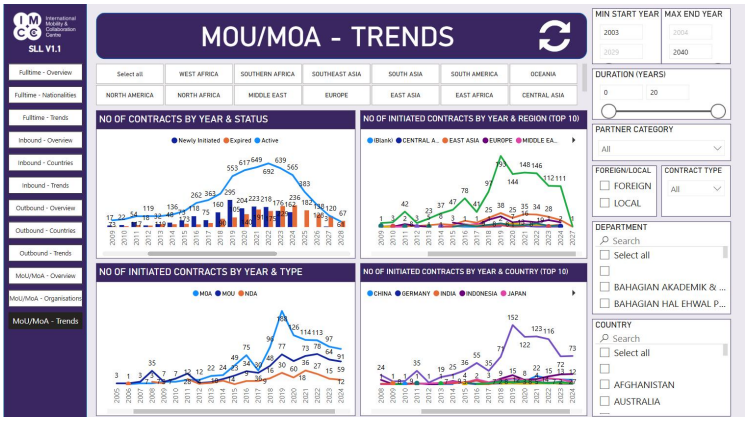

Fig. 7. Partnership trends

In the analysis depicted in Figure 7, Malaysia emerges as the country with the highest number of newly initiated partnerships across all the years, followed closely

by either Indonesia or China. This trend demonstrates the significance of local and regional collaborations in USM's network. Currently, USM maintains 565 active partnerships, with 182 of them set to expire in by 2025. This impending expiration number emphasizes the need for strategic planning and proactive efforts to manage and potentially renew these partnerships.

5 Ongoing Work

Since the completion of this project, preliminary feedback from USM stakeholders has been overwhelmingly positive. They have noted improved data accessibility and better decision-making capabilities. This qualitative feedback indicates that the dashboard has already successfully addressed several challenges related to data dispersion and analysis, providing a data-informed approach to support internationalization strategies.

However, we intend to conduct a formal study to quantify the efficiency gains in order to further corroborate these discoveries and provide a more thorough evaluation of the dashboard's impact. This study will measure reductions in the time needed for data retrieval, analysis, and reporting processes, as well as quantifying improvements in the ease of data interpretation across USM departments. We will use these metrics to better refine the dashboard's design and better understand its contribution to sustainable resource management within USM. This ongoing evaluation will guarantee that the dashboard remains a robust, sustainable tool for decision-making, and that it will stay aligned with the university's commitment to sustainable internationalization strategies.

6 Conclusion

In conclusion, the development and deployment of a descriptive dashboard to support Universiti Sains Malaysia's (USM) internationalization strategies exemplify a sustainable approach in higher education management. Through the consolidation of diverse data sources into a centralized, online platform, this project reduces environmental impact and resource waste by offering a single access point for all relevant internationalization metrics. The dashboard's insights into student mobility, partnership dynamics, and collaboration patterns provide USM with the means to make informed, strategic decisions that promote long-term, sustainable growth in its global engagements.

This project examines the role of data-driven solutions in enacting eco-conscious practices within higher education institutions, setting an example for minimizing energy costs and enhancing transparency. As a model of sustainable innovation, it encourages other institutions to adopt similar applications, promoting a culture of accountability, resource management, and strategic planning across the Malaysian and global higher education landscape.

7 References

1. Knight, J.: Higher Education in Turmoil. BRILL (2008). https://doi.org/10.1163/9789087905224.
2. Strategic Plan for International Cooperation (SPIC), http://marcopoloproject.eu/wp-content/uploads/2020/07/SPIC-partners-2.pdf.
3. Caballero Andaluz, R.: Internationalisation of Higher Education in South East Asia: a Perspective from the Marco Polo Project. Editorial Universidad de Sevilla (2020). https://doi.org/10.12795/9788447229420.
4. de Wit, H., Altbach, P.G.: Internationalization in higher education: global trends and recommendations for its future. Policy Reviews in Higher Education. 5, 28–46 (2021). https://doi.org/10.1080/23322969.2020.1820898.
5. Lauring, J., Selmer, J.: Is university internationalization bad for performance? Examining two different types of diversity. Int J Educ Res. 49, 161–171 (2010). https://doi.org/10.1016/j.ijer.2011.02.002.
6. Shvetsova, O.A.: International activity of russian universities. Case study of St.-Petersburg electrotechnical university "LETI." In: 2016 IEEE Conference on Quality Management, Transport and Information Security, Information Technologies (IT&MQ&IS). pp. 207–210. IEEE (2016). https://doi.org/10.1109/ITMQIS.2016.7751958.
7. Franklin, A., Gantela, S., Shifarraw, S., Johnson, T.R., Robinson, D.J., King, B.R., Mehta, A.M., Maddow, C.L., Hoot, N.R., Nguyen, V., Rubio, A., Zhang, J., Okafor, N.G.: Dashboard visualizations: Supporting real-time throughput decision-making. J Biomed Inform. 71, 211–221 (2017). https://doi.org/https://doi.org/10.1016/j.jbi.2017.05.024.
8. Bartlett, J., Tkacz, N.: Governance by Dashboard A Policy Paper. (2017).
9. Sanusi, D.M., Sujairi, N.S., Lutfi, S.L., Kharunizan, A.I.M., Feisal, S.D.S.A.A.: An Interactive Alumni Tracking Dashboard. In: An Interactive Alumni Tracking Dashboard. 2023 6th International Conference on Applied Computational Intelligence in Information Systems (ACIIS), Bandar Seri Begawan, Brunei Darussalam. https://doi.org/https://doi.org/10.1109/ACIIS59385.2023.10367325.
10. Hilger, L., Downing, C.: The surprising leaders of international student mobility, https://www.eaie.org/resource/surprising-leaders-student-mobility.html, last accessed 2024/02/02.
11. INDUSTRY-COMMUNITY NETWORK INFORMATION SYSTEM (ICN-IS), INDUSTRY-COMMUNITY NETWORK INFORMATION SYSTEM (ICN-IS), last accessed 2023/10/30.
12. Richardson, B.: Getting started with Query Editor in Power BI Desktop, https://www.sqlshack.com/getting-started-with-query-editor-in-power-bi-desktop/, last accessed 2024/01/31.
13. Data Visualization: Microsoft power bi, https://powerbi.microsoft.com/en-us/, last accessed 2023/11/20.
14. Streamlit, https://streamlit.io/, last accessed 2024/05/02.