The Power of Information Visualization for Understanding the Impact of Digital Media Projects

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Abstract: This study aims to understand the most effective way to present the results and impacts of research projects in the field of Digital Media collected by the Digital Media Observatory. The focus is developing dashboards using InfoVis tools and Business Intelligence to showcase a large volume of collected data, with a team of Students@DigiMedia. Takes an exploratory approach with three main phases: researching available InfoVis tools, creating sample dashboards using InfoVis tools, and implementing project dashboards using Power BI. The team of students has developed dashboards that provide a clear, structured view of the project, aggregating the following information: title, logo, objectives, keywords, funding, human resources, partners, methodological procedures, scientific and technological products, publications, dissemination, recognition, and SDGs. These dashboards provide interactive reports and visualisations to help researchers analyse, and communicate project results. This study can help to improve the overall data presentation experience, simplifying the analysis and knowledge-sharing process within the digital media research community.

1 INTRODUCTION

This article is part of Students@DigiMedia[1], an initiative created by the DigiMedia Research Centre at the University of Aveiro to encourage student participation in scientific research activities. This study aimed to assist the Digital Media Observatory (DigitalOBS) team at this Research Centre in presenting the extensive data collected from 40 scientific projects conducted by the centre's researchers over the past five years engagingly and dynamically. The intention was to develop an interactive and visually appealing platform that would effectively showcase the wealth of knowledge and discoveries generated by these projects.

Given the substantial information associated with research projects, Information Visualization techniques were proposed to generate a graphical dashboard model, to present a comprehensive set of information effectively.

By utilizing a Performance Assessment Model (PAM) (Tymoshchuk et al., 2024), the team were able to identify the most relevant data for presentation and aggregation of information. Selecting the data that would best represent the project graphically within each category of inputs, outputs, and impacts was crucial.

By incrementing the model developed, we were able to produce a standard model for presenting the associated projects, assuming a visual report for each one. This approach involved creating several dashboards using various software applications throughout development. Ultimately, a model was developed and is currently being implemented on the

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DigitalOBS website to present the results of scientific projects.

2 THEORETICAL FRAMEWORK

In recent decades, funding for scientific research projects has increased to promote innovation, knowledge transfer, and the achievement of the Sustainable Development Goals (Santos, 2022). These projects aim to address complex social problems through collaboration between different fields and develop various technological and scientific products. However, challenges arise in evaluating and managing these projects, particularly in terms of accountability and rigorous evaluation. Traditional bibliometric indicators are being questioned, and there is a need for qualitative approaches to assess research quality. It is also important to consider the temporal phases and the long-term impact of research (Saenen, et al., 2019; Santos, 2022).

The international scientific community proposes fairer evaluation models that combine quantitative and qualitative approaches. As research becomes more collaborative and interdisciplinary, new evaluation methods are necessary to capture the full impact and value of scientific contributions. This includes practices such as data sharing, open science, and consideration of societal impact (Djenontin & Meadow, 2018; Frey & Widmer, 2009; Patrício et al., 2018).

Effective communication plays a crucial role in fostering comprehension and advancement, particularly within the academic sphere, while also exerting influence on the corporate and business sectors. Within the realm of the corporate and business sector (Ansari, Barati & Martin, 2022; Horttanainen & Virrantaus, 2004; Hepworth, 2016).

Data visualization refers to a collection of methodologies that extract pertinent information from extensive quantities of unorganized or diverse data (Shneiderman, 1996; Plaisant & Shneiderman, 2022). Adopting information visualization techniques facilitates the transformation of intricate data into a more easily understandable format.

Applying efficient communication techniques facilitates the dissemination of research outcomes comprehensibly and easily accessible to the broader public (Bacic & Fadlalla, 2016; Binder & Blettner, 2015).

From a developmental perspective, variants and subtypes are generated through data and scientific visualization techniques, such as cartographic visualization, or within the realm of knowledge, such as statistical visualization. Information Visualization, (InfoVis), is a technique that facilitates and enhances the examination of extensive datasets (Jiang, Hou & Yang, 2023). The objective of this endeavour was to facilitate users in researching, comprehending, and scrutinizing data through a gradual and repetitive approach to visual exploration (Sorapure, 2019; Wolff et al., 2016).

The effective use of data visualization in a proficient manner enables a complete evaluation of research centre initiatives, facilitating the communication of results in a visually captivating and instructive manner. This phenomenon can potentially enhance decision-making processes, optimize resource allocation, and foster increased transparency among both domestic and global players (Pinto, Raposo & Ramos, 2012). Illustrate the collaborative associations among researchers, internally inside the centre and externally with external partners (Zhu et al., 2020).

InfoVis enables the presentation of performance measurements using conventional visual representations, such as line graphs, scatter plots, or stacked bar charts. Data visualization techniques facilitate the identification of trends, patterns, and impacts within research project data (Andrienko et al., 2021; Shirato, Andrienko & Andrienki, 2023). The accessibility of visualized data to various stakeholders is facilitated by utilizing online platforms or software tools, which in turn allows for secure data sharing and collaborative engagement among academics (Lima, 2011).

The application of Artificial Intelligence (AI) and Business Intelligence (BI) tools can facilitate understanding the vast amount of data generated in research projects, providing a comprehensive and up-to-date view of the research's scope, influence, and relevance (Khatuwal & Puri, 2022). Business data visualisation is primarily used for communication, information seeking, analysis, and decision assistance, in contrast to other visualisation kinds and uses (Zheng, 2018).

Microsoft Power BI is a BI platform that offers its users a package of tools for aggregating, analysing, and visualising large amounts of data from one or more sources, allowing them to obtain relevant insights from this data and thus help with decision-making (Becker and Gould, 2019). Power BI has an accessible and intuitive interface that allows users, regardless of their knowledge of programming or visualisation, to create interactive reports and dashboards that can then be shared with other users or published on the web. It also supports real-time data updating, ensuring that the visualisations presented show the most up-to-date information (Orts, 2004).

Therefore, applying BI tools, such as Power BI can help Research Centres understand the complex results generated by various scientific projects, facilitate data-based decision-making for future projects and improve work efficiency.

3 METHOD

This study was conducted as part of the DigitalOBS, which aims to monitor and analyse trends in digital media, provide valuable information on the social impact of media, and serve as a collaboration platform for researchers, policymakers, and stakeholders in the field of digital media.

The DigitalOBS team analysed the results and impacts of research projects conducted by DigiMedia researchers over the past five years to help define this research centre's development strategies. To achieve this, the DigitalOBS team created an analysis model that examines crucial aspects such as funding evolution, human resource composition, research methodologies, scientific and technological results, and dissemination of research findings (Tymoshchuk et al., 2024).

- This model provides a structured approach for evaluating scientific projects in Digital Media, focusing on three main dimensions: input, output, and impact.
- The “Input” dimension analyses the resources allocated to the project, including funding, human resources, new infrastructures, collaborations, and characteristics of the scientific area.
- The "Output" dimension consists of four main sub-dimensions: methodologies, scientific and technological products, publications, and dissemination of activities.
- The third dimension, "Impact," focuses on the long-term consequences of a project,
- considering economic, social, cultural, environmental, political, and recognizable impacts (Tymoshchuk et al., 2024).

This dimension aims to understand the variability of the results of applied research. This model has been developed to incorporate data analysis and visualization tools, enabling researchers to present data quickly and easily through interactive reports and dashboards.

Due to the large volume of results generated by the projects, the decision was made to explore the potential of BI tools to analyse and visualize this data. Therefore, the main goal of this study is to develop dashboards that effectively present the key results of research projects, integrating advanced BI technology. These panels can help researchers analyse, interpret, and communicate the results of their projects interactively, engagingly, and quickly.

The study followed an exploratory approach that encompasses three main phases:

i) Analysis of available InfoVis tools, evaluating their characteristics, functionalities, and suitability for the specific requirements of the research centre.
ii) Construction of dashboard examples using InfoVis tools (Figma), categorizing and organizing the results and impacts of research projects according to the developed analysis model.
iii) Implementing project dashboards using BI tools (Power BI), aims to help researchers create and share interactive reports and dashboards, simplifying the analysis and communication of knowledge and improving the overall data presentation experience.

This study significantly improves the overall data presentation experience by integrating robust data analysis and visualization tools, simplifying the analysis and communication of knowledge within the digital media research community.

4 RESULTS

4.1 InfoVis Tools – Analysis and Selection

The first step involved clearly defining what information must be communicated through InfoVis. In this case, the goal was to effectively visualize the results of DigiMedia research projects, thus providing a valuable resource for the team and stakeholders.

The Observatory team had already surveyed 40 research projects conducted at this Research Centre using the developed evaluation model. Therefore, there was a strong need to present this information in a clear, appealing, and interactive manner. Considering the large amount of data and the project's time constraints, it was decided to find an InfoVis tool that would enable us to present this data quickly and effectively.

The team went through an extensive evaluation process, examining a wide range of tools and their capabilities (Table 1).

Table 1: Criteria by existing InfoVis tools and literature.

Category	Tools
Desktop software tools	Power BI, QlikView
Libraries and programming framework tools	D3.js, Matplotlib (Python), ggplot2 (R)
Online tools	Flourish, Plotly, Genially
Design tools	Figma, Canva, Infogram, Visme

The team then categorized the tools analyzed into four distinct categories to facilitate the comparison and selection process, allowing the team to make an informed decision on the most suitable tool for the project. This categorization was based on a combination of existing literature on InfoVis tools, and the subjective criteria established by the team, (Table 1). According to the tools found, the next step was the selection process. The work team decided to use the online tool Genially, because it is customizable, offers predefined templates and has a free version available.

4.2 Dashboard Model Development

The initial drafts of the project dashboard were created using Genially, as shown in Figure 1.

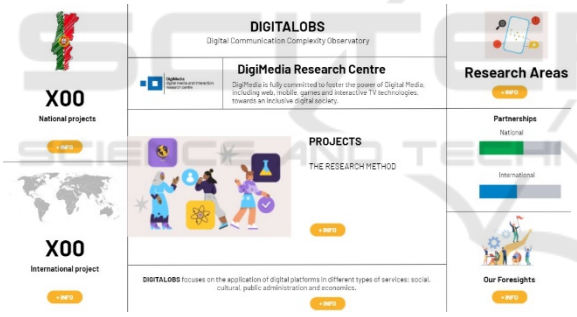

Figure 1: Drafts of dashboards created using Genially.

These drafts were carefully reviewed and approved by the DigitalOBS team. However, while creating the interactive prototypes, the researchers of Students@DigiMedia realized that the free version of Genially had some limitations. These included a minimum number of allowed changes and the absence of certain graphic and interactive features.

As a result, the team of Students decided to switch to using the Figma tool instead. Figma is an intuitive vector graphic design editor that provides a wide range of image optimization capabilities. Using Figma, the team successfully created interactive panels for two noteworthy projects: Seduce 2.0 and HiLives. It was important for the team to ensure that these dashboards possessed a consistent visual identity across both projects. The team chose this deliberate approach to facilitate a quicker and more effective comprehension of each project.

After conducting a comprehensive review and adaptation exercise, the team identified the visual models that were most suitable for effectively communicating DigiMedia projects (see Figure 2 – Seduce and Figure 3 - HiLives).

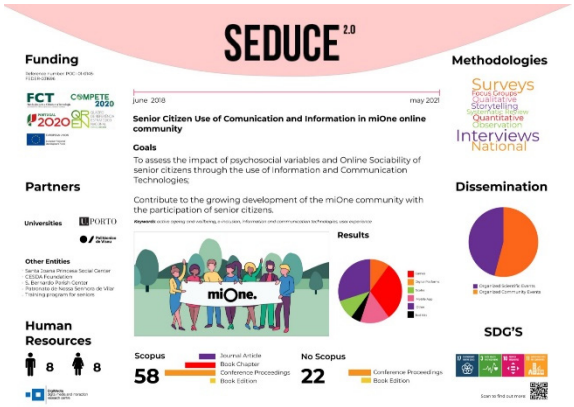

Figure 2: Visual model created using Figma, Seduce project.

After careful consideration, the dashboard displayed in Figure 3 was ultimately chosen as the final model for presenting the data from the collected projects. This designed dashboard was implemented in Power BI, ensuring a practical and visually appealing representation of the project data.

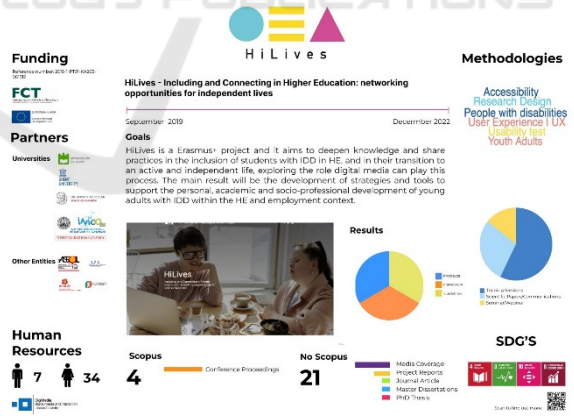

Figure 3: Visual model created using Figma, HiLives project.

The dashboard prominently showcases the project's title, objectives, and logo. The remaining information is visually organized into three distinct blocks: inputs, outputs, and impact. This arrangement allows for highlighting key milestones and moments within each project. As a result, stakeholders can easily monitor and assess the progress and effectiveness of the

projects. The input block provides detailed data regarding the resources that have been invested, such as funding, human resources, and partners. The outputs block focuses on the services and results achieved, such as the scientific-technological products developed, methodological procedures implemented, publications, dissemination activities and sustainable development objectives achieved. Lastly, the impact block measures the long-term effects and benefits of the projects, such as improvements in society, the economy, or the environment and acknowledgement.

4.3 Implementation by BI Tools – Power BI

Within the scope of this work, Power BI was used to develop a multi-page report focussing on crucial aspects of the various projects developed by DigitalOBS researchers, including details of the projects carried out, human resources involved, collaborations between institutions, methodologies applied, and resulting publications. Each of these pages is organised as a dashboard offering an immediate summary of the data under analysis (Orts, 2004). Initially, the various DigiMedia labelled projects' technical sheets were analysed to detect patterns and define a structure for the file that would feed the Power BI report. This source file consists of an Excel file published online via SharePoint and shared between DigiMedia members who have permission to update it whenever new projects or changes to existing ones appear.

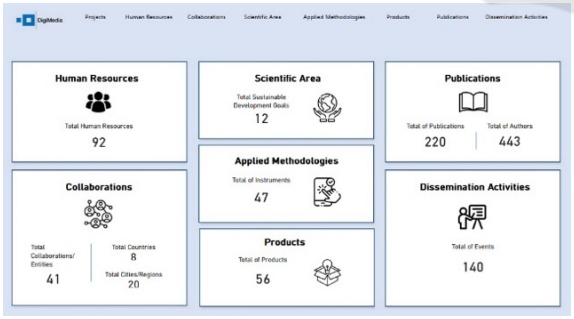

Figure 4: Page structure of the report developed in Power BI with the project's data.

Their structure is identical and in the majority of cases is divided into three sections: a top bar identifying the various pages of the report as well the indication of which one is currently selected (A), a small area with various filter options that allow to segment the data presented (B) and finally a larger area with various related visual elements that allow to interact and gain insight from the data presented (C).

The report, developed in Power BI, consists of 11 pages in total. The first page is an aggregation of the main numbers related to the various projects developed by DigiMedia researchers. It is possible to analyse in detail the origin of the number in question by navigating to the page where it is desiccated.

It is also possible to create a dashboard that displays the most critical information for each project. This page was created using the project presentation template developed in the previous phase. Figure 5 shows the page summarizing the main project numbers.

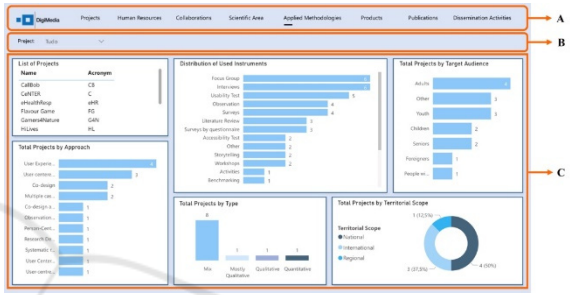

Figure 5: Summary page of the main projects.

The Power BI report effectively combines and aggregates all the essential project data, providing a comprehensive overview. It is a centralized hub, allowing researchers and stakeholders to access crucial information immediately. The remaining pages are the following: Projects; Human Resources; Collaborations; Scientific Area; Applied Methodologies; Products; Publications; Dissemination Activities; and Researchers.

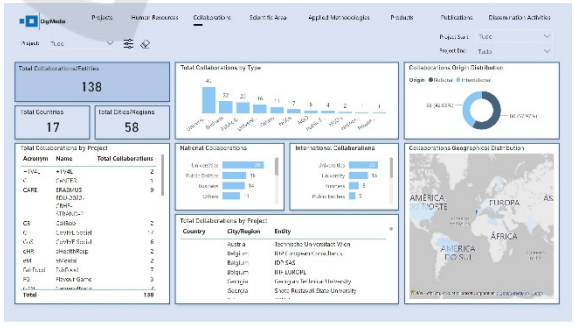

Figure 6: Pages created by Power BI with the Project's data.

Each Power BI dashboard provides a visual representation of project data, national or international level, based on the type of partnership. The partners' locations are displayed on a map, illustrating their geographical distribution through dots (Figure 6).

Regarding the scientific domain, word clouds are useful for efficiently summarising material and identifying the most prominent concepts within scientific fields and keywords. Additionally, each project is assigned a specific number of Sustainable Development Goals (Figure 7), which enables the team to have a more comprehensive understanding of the primary focus areas.

Figure 7: Pages created by Power BI with Scientific Areas data and SDG's.

In Figure 8 we can see a more detailed table of the methodologies applied in the projects, such as the type of scientific research, the type of approach taken, the instruments applied, the target audience and at what geographical level the projects were implemented.

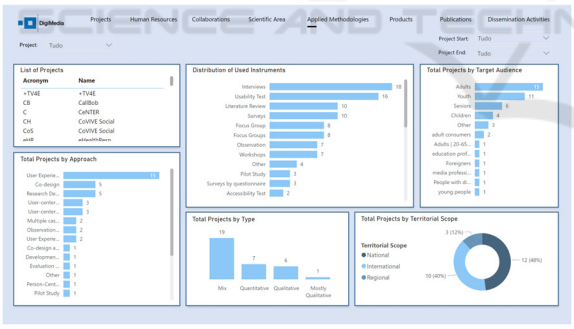

Figure 8: Pages created by Power BI with Applied Methodologies data.

Digital media projects, whether national or international, typically involve developing diverse scientific and technological products. Hence, the team has recognised the significance of categorising the product menu based on the type of product. This can be visualised either through a horizontal bar graph or a project-specific list (Figure 9).

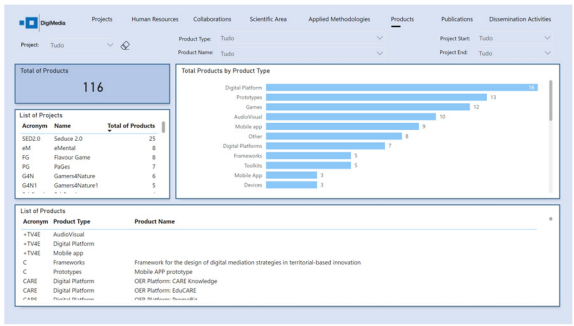

Figure 9: Pages created by Power BI with product data.

Scientific publications play a crucial role in the success and progress of research centre projects in terms of being the primary means of disseminating research findings to the wider scientific community. They allow researchers to share their discoveries, methodologies, and insights with other experts in the field. Peer-reviewed publications enhance the credibility and reliability of research (Figure 10). So, publications contribute significantly to the academic recognition of researchers and the research centre itself. The number and impact of publications are often used to indicate the research centre's productivity and reputation within the scientific community. Collaborations and partnerships often arise from shared research interests and complementary expertise demonstrated through published work. Therefore, published research can lead to the development of new technologies or applications. This knowledge transfer from academia to industry can result in innovations that benefit society and contribute to the research centre's impact.

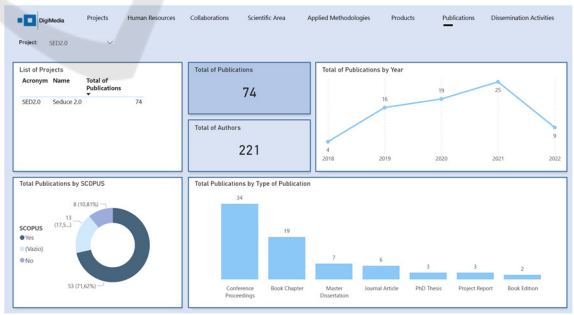

Figure 10: Representation of Seduce2.0 project publications created using Power BI.

Dissemination Activities serve to enable the transmission of knowledge from the research centre to diverse stakeholders, encompassing other researchers, policymakers, industry experts, and the general public. This guarantees that the research findings are readily available and practical for a wider

audience beyond the academic community. Research centres can foster and enhance connections with other research institutions, universities, and organisations by disseminating research outputs through conferences, workshops, and publications (Figure 11). Networking is crucial for cultivating a cooperative research environment. Additionally, they enhance the enduring significance and influence of research findings by assuring their ongoing relevance. It contributes to ensuring the creation of a sustainable legacy for the research centre.

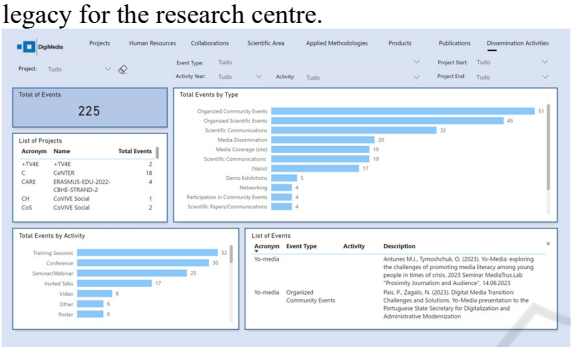

Figure 11: Pages created by Power BI with Dissemination Activities data.

Furthermore, efforts have been made to ensure the accessibility and responsiveness of the platform, making it compatible with various devices and screen sizes. Users can easily click on any topic of interest to dive deeper and explore more detailed information. Additionally, the dashboards offer indicators side by side, facilitating data-driven decision-making.

The quality of data directly impacts the excellence of study findings. Accurate, dependable, and correct data are essential for producing strong discoveries, publications, and contributions to the scientific community. Research centres focus heavily on data-driven decision-making. Accurate and relevant data is essential to make informed and evidence-based decisions, whether it's for planning future initiatives, allocating resources, or developing strategies. Data enables research centres to establish a baseline for their discoveries by comparing them to current knowledge and evaluating their findings concerning previous studies.

Data play a crucial role in the scientific method, exerting influence over research's calibre, rigour, and significance. This study is in line with other studies (Szołtysik, 2017; Zheng, 2018) that reveal the importance of applying visualisation information with BI tools, where is possible to convert unprocessed data into valuable and practical information for human consumption.

5 CONCLUSIONS

This study focuses on developing dashboards using InfoVis and BI tools to effectively present research project results and impacts.

The DigitalOBS team collaborated with students from the Department of Communication and Art, participating in the Students@DigiMedia initiative. The students' involvement not only provided them with valuable hands-on experience in data visualization but also brought fresh perspectives and innovative ideas to the project. Overall, this collaboration between the DigitalOBS team and the Students@DigiMedia initiative demonstrated the power of interdisciplinary collaboration in research investigation.

Together, the team created a graphic model using InfoVis techniques to effectively communicate a comprehensive set of information related to the results of scientific projects. The integration of InfoVis tools and AI technology has greatly enhanced the presentation of data and can facilitate knowledge-sharing and decision-making processes.

This study developed a Power BI report, each dedicated to a specific aspect of the research projects. By providing researchers with intuitive and visually appealing tools to present their project results, this study has the potential to enhance collaboration, facilitate data-driven decision-making, and accelerate the advancement of research in the digital media field. The findings of this study not only benefit DigitalOBS by allowing analysis of the research project's outcomes but also showcase the potential of InfoVis and AI tools in the academic and research context.

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