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Nova IMS Contribution for SDGs achievement

A Business Intelligence Approach

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Project Work report presented as partial requirement for
obtaining the Master's degree in Statistics and Information
Management

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NOVA IMS CONTRIBUTION FOR SDGS ACHIEVEMENT

by

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Project Work report presented as partial requirement for obtaining the Master's degree in Information Management, with a specialization in Knowledge Management and Business Intelligence

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ABSTRACT

To achieve a sustainable future, some planet earth problems have to be solved. Problems can be caused by natural processes, such as changes in the sun's radiation, volcanoes or internal variability in the climate system, or due to human influences such as changes in the composition of the atmosphere, land use and resources use (World Health Organization, 2013). These changes in the atmosphere composition are influenced by ordinary factors, such as industries, agriculture and even the economy status of the society.

The United Nations have a set of 17 interdependent Sustainable Development Goals (SDGs) designed to be a "blueprint to achieve a better and more sustainable future for all" (United Nations, 2017). These goals were set in 2015, and they are intended to be achieved in 2030.

HEIs are core intervening entities in the achievement of these goals because they are the main drivers of innovation and economic development which means that they provide knowledge and solutions for the framework implementation and create current and future SDG implementers and HEIs can also benefit from this framework.

The core drive of the project is to understand the impact and contribution of Nova IMS activities in the SDGs achievement. Through the development of a Power BI report, the institution will be able to quantify how much is contributing for each SDG in several areas and understand what are the ones calling for action.

KEYWORDS

Sustainable Development Goals; Higher Education Institutions; Sustainability; Power BI; Business Intelligence; Nova IMS

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LIST OF ABBREVIATIONS AND ACRONYMS

BI	Business Intelligence
UN	United Nations
SDGs	Sustainable Development Goals
ESD	Education for Sustainable Development
SDSN	Sustainable Development Solutions Network
HEI	Higher Education Institutions
THE	Times Higher Education
ETL	Extract Transform and Load
SSBI	Self-service BI
DSS	Decision Support System
DSR	Design Science Research

1. INTRODUCTION

1.1. BACKGROUND AND PROBLEM IDENTIFICATION

According to Bachmann (2010), sustainability has become the subject for a contemporary assessment of progress and responsibility, freedom and culture (Spindler, 2013).

The demand for raw materials and the environmental impact it causes, have been a constant issue throughout human history. Western societies started to discover that their economic and industrial activities had a significant impact on the environment and the social balance, in the second half of the 19th century. Several ecological and social crises took place in the world and rose awareness that a more sustainable model was needed (Du Pisani, 2006).

In 1987, the Bruntland Commission Report explains the concept of sustainable development as the “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (UNESCO, 2012).

Overpopulation and scarcity of raw materials are just two of the many reasons why sustainable development is needed. Several laws and agreements were established in order to control some indicators and act through them, to a cleaner and more sustainable world. In that regard, in 2015, the United Nations (UN), created the 2030 Agenda, build on top of 17 Sustainable Development Goals (SDGs) which are an urgent call for action by all countries - developed and developing - in a global partnership. The focus of this goals is the end of poverty, the inequality fight and the urgency of climate change. They should work as a guide for governments, businesses and citizens to build a better future (United Nations, 2015).

The education sector also has the concern in meeting the goals, since it is one of the fewest that can promote and contribute the most for all SDGs. Education is the major pillar to follow this continuous line of development. Education for Sustainable Development (ESD) encompasses environmental education but sets it in broader context of social-cultural factors and the socio-political issues of equity, poverty, democracy and quality of life (Venkataraman, 2009).

As individuals and societies, we need to learn to live together sustainably and take action responsibly, understanding the implications of what we do today, on the planet and the people in the future. ESD empowers people to change the way they think and work towards a sustainable future (UNESCO, 2012).

Universities are uniquely placed to lead the cross-sectoral implementation of the SDGs, providing an invaluable source of expertise in research and education on all sectors of the SDGs, in addition to being widely considered as neutral and influential players (El-Jardali et al., 2018).

This important role is because universities are prerogative entities in knowledge production and communication from education and in promoting the concept of sustainability through investigation (Junior et al., 2019).

To promote the SDGs, the Universities have to include sustainable development in their activities by identifying the content and activities linked to them and provide training to reinforce the didactic content (Albareda-Tiana et al., 2018). According to Sustainable Development Solution Network

(SDSN), Universities can implement the SDGs in four activities: teaching, research, operations and leadership (Australia/Pacific SDSN, 2017).

Nova IMS is a renowned university and stands for “effectively using available resources as well as maintaining high level of management responsibility” (Nova IMS, 2021). The institution created a network of people and organizations called **NOVA IMS – Urban Analytics Lab** that intends to make its contribution to the development of a more responsible and solidary society, basing its academic and scientific ambitions in strategic partnerships with scientific and professional communities. In this sense, and in a continuous and sustainable way, NOVA IMS creates partnerships for development, promoting synergies with national and international partnerships in several areas (Nova Cidade, 2021).

To allow Nova IMS to know the positioning regarding the SDGs, the development of a Business Intelligence (BI) framework is the solution. This framework will allow end users to analyze the data in an efficient and on-time way, will help managing the sustainable related activities and the efforts and risks for the identification of new opportunities in the future and in the end, to help the decision-making process.

This project is developed in Microsoft Power BI and it classifies and map the education and investigation activities that contribute for the SDGs achievement while contributing for the institution to monitor and communicate the sustainable practices and to understand the commitment with the 2030 Agenda.

1.2. STUDY OBJECTIVES

Taking into account the importance of the Universities in the SDGs accomplishment, the main purpose of this project is the development of a BI solution that classifies the education and investigation activities as well as projects, thesis and publications works, and that allows the institution to track and communicate their contribution. This solution is based in Power BI dashboards taking into account the SDGs matrix defined in the 2030 Agenda.

In pursuance of the project’s main goal and taking in account different sources of information and the approach selected, the steps to follow are:

1. Get familiar with the SDGs and their indicators;
2. Investigate similar projects in educational establishments and the methodology used;
3. Select the data bases of the activities and relate them with SDGs;
4. Format source files for the project purpose;
5. Upload the data collected in Power BI and do the final transformations to it;
6. Create a relational model including all the facts and dimensions needed;
7. Create measures to study the classification of the activities;
8. Prepare some dashboards for data visualization;
9. Perform tests for data veracity;
10. Understand the results and take conclusions from them;
11. Identify improvement opportunities.

1.3. METHODOLOGY

The methodology used in this project is Design Science Research (DSR) for Information Systems since it is oriented to the creation of successful and innovative artifacts.

As an iterative process, DSR aims to identify the problems in a problem space and to contribute and evaluate different solutions in the solution space. Generate knowledge about innovative solutions for real-world problems is the main goal of DSR because it has ability to contribute to digital transformation and address several society challenges like environmental sustainability (vom Brocke & Maedche, 2019).

DSR is a process with multiple iterations and that must be considered when modifications occur and affects all the flow. To build a successful project, 5 phases must be considered (Vaishnavi et al., 2019), awareness of the problem, suggestion, development, evaluation and conclusion.

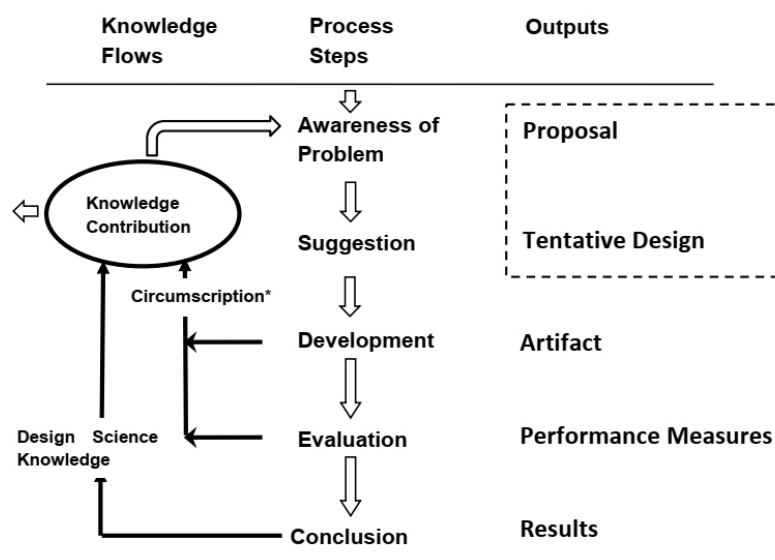


Figure 1- DSR Process Model (Vaishnavi et al., 2019)

- 1) **Awareness of the problem:** Sustainable development is a big concern for all institutions, and universities are important entities that can contribute more to the cause. The motivation for this project was to quantify the current contributions to the different SDGs from Nova IMS as a renowned university that has the responsibility to contribute and know the positioning in the different areas, to improve others that have less inputs and potentiate them.
- 2) **Suggestion:** In this project phase, was designed a prototype view of the final artifact. The development of a dashboard with different views from the SDGs perspective was the suggested solution to the problem identified earlier. Through this development, NOVA IMS will be able to know the positioning regarding all SDGs considering education, projects, thesis, publications and investigation.
- 3) **Development:** The effective implementation of the dashboard suggested in the previous phase. Data was collected with and by NOVA IMS and it was transformed to fulfill the needs of the project. The tool was selected considering the literature review done and the project

was developed in this phase. To add more value to the solution, the data structure was developed ready to be transposed for other NOVA entities.

- 4) **Evaluation:** In this phase the project was evaluated to understand if the requirements and objectives were fulfilled and assess the added value it brings to the institution.
- 5) **Conclusion:** Present results and take conclusions from them are the main topics of this phase. Here NOVA IMS will be able to determine new policies and practices based on the data and results presented. The project can also work as a pilot for other NOVA entities.

2. STUDY RELEVANCE AND IMPORTANCE

Higher Education Institutions (HEI) are seen as specially equipped agents to lead the way in search of sustainable development (Tauchen & Brandli, 2006), since they constitute spaces for “reflection, formation and diffusion of new concepts of development and sustainability, participating in a broader perspective of establishing more just, supportive and environmentally sustainable societies” (Gazzoni et al., 2017).

This project will allow Nova IMS to know the positioning of SDGs implementation in the institution and will provide a greater capacity for critical analysis and decision-making, based on the mapping of the current situation and thus allowing the identification of the less referred SDGs of the institution, bringing more focus to them.

The project will allow the institution to take all the advantages of a BI solution:

- Automation of the process of mapping the activities carried out by the institution;
- Reduction in time;
- Greater efficiency in carrying out the processes and obtaining information;
- Higher quality of information;
- Presentation of information through simple and intuitive dashboards;
- Analyze and cross-check data from different sources;
- The analysis of evolution over time;
- The presentation of a set of metrics and significant indicators;
- Better access to information. Thus, this initial work is essential to help define the next steps in relation to the institution's strategy.

In addition to all advantages, this project will demonstrate Nova IMS commitment and academic contribution and will allow the institution to define the next steps in the strategy for SDGs accomplishment.

The development of the report will be using Microsoft Power BI. Microsoft (2017) aligns strongly with the United Nation’s global agenda for sustainable development. There are several case studies and initiatives redirected for each SDG. There are also several reporting solutions addressing the targets of the SDGs for several companies, governments and even HEIs.

“Universities and Sustainable Development Goals” is a project developed by the “Alliance for Sustainability Universities” that maps, through keywords, the investigation projects and scientific publications of 13 universities to find their focus areas related to sustainability. The goal of this project is to reinforce the integration of sustainable development in the HEIs activities (Körfgen et al., 2018).

Universities that are part of Aurora network, are present in the “SDG Analytics: Bibliometrics of Relevance”, an interactive Power BI dashboard that shows the relevance and the social impact of the research activities related to the SDGs. It allows to quantify the contribution and to identify the importance of the publications based on their bibliometric indicators (Aurora, 2018).

In 2019, The World University Rankings, created Times Higher Education (THE), that measures the success of HEIs in delivering the SDGs through global performance tables. Carefully calibrated

indicators are used to provide comprehensive and balanced comparisons across three areas: research, outreach and stewardship (Rankings, 2020).

The literature review of this project is also important because it will contribute to the relevance of the SDGs theme in HEIs aligned with BI and will also raise awareness to the subject.

Nova IMS is an institution that was always recognized for leading in innovation, because of that this approach can be used to encourage other institutions to explore the theme that is extremely significant nowadays.

3. THESIS METHODOLOGY

As stated by Solomon Negash and Paul Gray (2008), “Business intelligence is a data driven DSS that combines data gathering, data storage, and knowledge management with analysis to provide input to the decision process” (Negash & Gray, 2008).

A BI approach will be conducted to create a Report with all the information relevant to analyze quantitatively the contribution of Nova IMS to the SDGs in terms of investigation/research and education activities as well as projects, publications and thesis. Power BI Desktop will be the main software used for this project, not only because it is recognized as a leader by Gartner Magic Quadrant (Figure 1) for Analytics and Business Intelligence Platforms in the last 13 years (2020), but also because it allows to connect different sources of data, combine them, and it has monthly recurrence update to incorporate new features and customer feedback (Microsoft, 2020).



Figure 2- Magic Quadrant for Analytics and Business Intelligence Platforms (Gartner, 2021)

Firstly, a preliminary literature review will be done, to explore all the concepts. The SDGs will be the core of this project, so all the indicators related to it will be considered.

To guarantee the accuracy of the project, all data sources that will allow the analysis of the contribution to the indicators will be the ones available on the internet to everyone or databases provided from the institution. Some examples of the data sources will be:

- Sustainable Development Solutions Network (SDSN) - <http://ap-unsdsn.org/regional-initiatives/universities-sdgs/>;
- Nova IMS website - <https://www.novaims.unl.pt/default>;
- Nova IMS Moodle - <https://elearning.novaims.unl.pt>;

Data related to Course Units of Nova IMS, will be collected in the institution through surveys. In terms of Projects, Thesis, Publications and Investigation, Nova IMS has been collecting data and structure it in several data bases where classifies the different works according to the related SDGs.

Some data transformations will be done firstly in Excel, to format the data bases to suit the purpose of the projects, and after in Power BI Desktop. Jan Van den Broeck, Solveig Argeseanu Cunningham, Roger Eeckels and Kobus Herbst (2005) present data cleaning as a “three-stage process, involving repeated cycles of screening, diagnosing, and editing of suspected data abnormalities” (Van Den Broeck et al., 2005). This part is one of the most important in Business Intelligence projects, and where data scientists spend 50% to 80% of their work (Lohr, 2014).

The main goal is to classify the activities of Nova IMS according to the SDGs, structure the data and finally create the proper metrics to analyze the evolution and prediction of them throughout the years in a user-friendly report designed in Power BI Desktop. The methodology can be translated in a deep search through Kimball Lifecycle approach applied to a BI project by the following schema (Kimball et al., 1998):

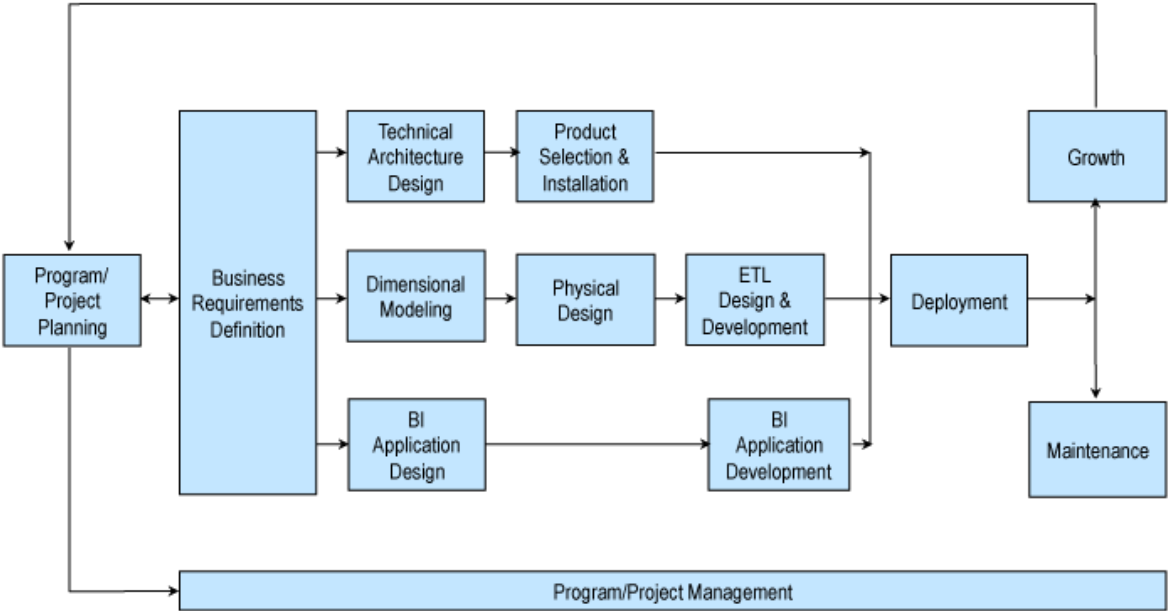


Figure 3- Kimball Lifecycle approach (Kimball et al., 1998)

4. LITERATURE REVIEW

4.1. SUSTAINABLE DEVELOPMENT GOALS (SDGs)

According to the UN, the 2030 Agenda for Sustainable Development, defined in September 2015, is one of the most ambitious and important global agreements in recent history. The main goal is to set the world on path towards a better future for all by 2030.

This agreement is based in 17 SDGs and 169 targets and should be seen as a guide for all countries (developed and in development), to set their priorities and face the world challenges in an organized manner. These challenges include poverty, hunger and climate change among others, to ensure that all people can enjoy prosperous, healthy and fulfilling lives while inserted in a peaceful, just and inclusive society free from fear and violence (Australia/Pacific SDSN, 2017).

UN Secretary-General Ban-Ki Moon has spoken numerous times about the importance of these goals and the direction they can take the world saying that “sustainability means ensuring prosperity and environmental protection without compromising the ability of future generations to meet their needs. A sustainable world is one where people can escape poverty and enjoy decent work without harming the earth’s essential ecosystems and resources; where people can stay healthy and get the food and water they need; where everyone can access clean energy that doesn’t contribute to climate change; where women and girls are afforded equal rights and equal opportunities” (Zahra, 2015).

To measure the progress of the SDGs, is to focus on the 5 areas of action, the 5P’s (Ho & Goethals, 2019):

1. **People:** poverty, hunger and equal rights related SDGs – SDG 1, 2, 3, 4 and 5
2. **Planet:** responsible production and consumption, climate change and natural resources related SDGs – SDG 6, 12, 13, 14 and 15
3. **Prosperity:** economic and social progress, health and prosperity related SDGs: SDG 7, 8, 9,10 and 11
4. **Peace:** peaceful, fair and inclusive societies related SDGs: SDG 16
5. **Partnership:** interconnection and joint mobilization for the most vulnerable related SDGs: SDG 17



Figure 4- The “five Ps” representing the broad scope of the 2030 Agenda for Sustainable Development, 2016-2030 (United Nations, 2021)

According to the United Nations Foundation (2019), the 5P’s highlight how the SDGs are an intertwined framework instead of a group of siloed goals (Brown & Rasmussen, 2019).

4.2. SDGs AND THE UNIVERSITIES

SDSN agrees that Universities are the main drivers of innovation and economic development and social wellbeing and because of that, the role of the institution is crucial to achieve the SDGs and it will also benefit from engaging with them, as explained in the next section.

4.2.1. SDGs contributing to Universities

SDGs have an important role in embedding sustainability into universities business strategies, decision making processes and practices while creating positive impact and improving their accountability to stakeholders (Junior et al., 2019).

The benefits for the Universities with the adoption of the SDGs framework are vast. Among them, the key ones are (Australia/Pacific SDSN, 2017).

Demonstrate University impact: to demonstrate to external stakeholders (government, funders and the community) how can an institution contribute to global and local progress and wellbeing.

- Capture demand for SDGs related education: to future proof the institution for all the changing circumstances that the planet is going through, an early adoption of SGD-related education is needed to appease the demand for graduates who understands and can implement the SDG agenda.
- Build new external and internal partnerships: the 2030 Agenda is a collective framework for different sectors to bond and make them work together on shared interests. Because of this adoption, the university will be able to create collaborations with the governments, companies and the community. In terms of internal partnerships, this approach can identify

common interests across different areas of the institution, motivating cross-disciplinary partnerships, collaboration and innovation.

- Access new funders: government agencies and international banks are framing new funding streams over the SDGs achievement.
- Be a responsible and globally aware university: to respond to society needs and to become an agent of change towards solving global challenges. Universities have a moral imperative to support the SDGs, because of the important role they have in ensuring the success of the SDGs.

4.2.2. Universities contributing to SDGs

Jeffrey D. Sachs (2015), Director of SDSN, claims that “Universities around the world should be in the lead of helping society to find the technical solutions to achieve these goals” (Sachs, 2015).

SDSN says that SDGs will not be achieved without universities, because the unique functions and expertise are crucial for overcoming the wide range of challenges. The key roles of universities are (Australia/Pacific SDSN, 2017):

- Provide knowledge and solutions for the framework implementation: Research, discovery and knowledge creation and adoption are driven by universities. These are needed to understand the challenges and opportunities between the SDGs and to develop and implement the solutions.
- Create current and future SDG implementers: Universities work as providers of people with skills, capabilities and a desire of a better world. SDGs achievement will be an everyone job and universities need to equip future leaders, innovators, entrepreneurs and citizens with the knowledge, skills and motivation that will help them contribute to achieve the SDGs.
- Embody the principles of the SDGs: As complex and diverse institutions, universities have significant footprints, that can contribute to the SDGs achievement by implementing the principles in their own governance, operations and culture
- Cross-sectoral leadership in implementation: The key role of universities, as neutral and trusted stakeholders of society, should be to create cross-sectoral partnerships and educate the public and other sectors for the importance of the SDGs.

4.2.3. SDGs integration in the Universities activities

HEIs that are committed to sustainability are struggling to contribute significantly to the theme, however their difficulty is related to initiating projects / initiatives that globally influence their culture and their stakeholders (Tilbury, 2012).

According to SDSN Australia/Pacific (2017), there are 4 pillars for the commitment of HEIs to the SDGs: research/investigation, education, operations and governance and external leadership. (Figure 4).



Figure 5- An overview of university contributions to the SDGs (Australia/Pacific SDSN, 2017)

4.3. BUSINESS INTELLIGENCE

Business Intelligence (BI) offers support as a Decision Support System (DSS) based on data and combines data gathering, data storage and knowledge management with analysis (Negash & Gray, 2008). BI systems allow companies to reduce costs, improve service quality and to have better decision-making processes which are the main reasons for the growing interest (Foley & Guillemette, 2011).

After an article written by Hans Peter Luhn, computer scientist in 1958, the concept of BI started to gain recognition (Luhn, 2010). In the beginning it was described as a automatic system to disseminate information through several sectors of a company. In 2004, one definition describes BI as the “process of turning data into information and then into knowledge” and “knowledge is typically obtained about customer needs, customer decision making processes, the competition, conditions in the industry, and general economic, technological and cultural trends” (Golfarelli et al., 2004).

Therefore, BI has the purpose of generate insights and important information to support the decision-making process (Wieder & Ossimitz, 2015).

4.3.1. BI Architecture

According to Kimbal & Ross (2013), operational source systems, ETL system, data presentation area and BI applications are the four components to consider in the BI environment are the 4 components to consider in the DV/BI environment (Kimball & Ross, 2013). (Figure 5)

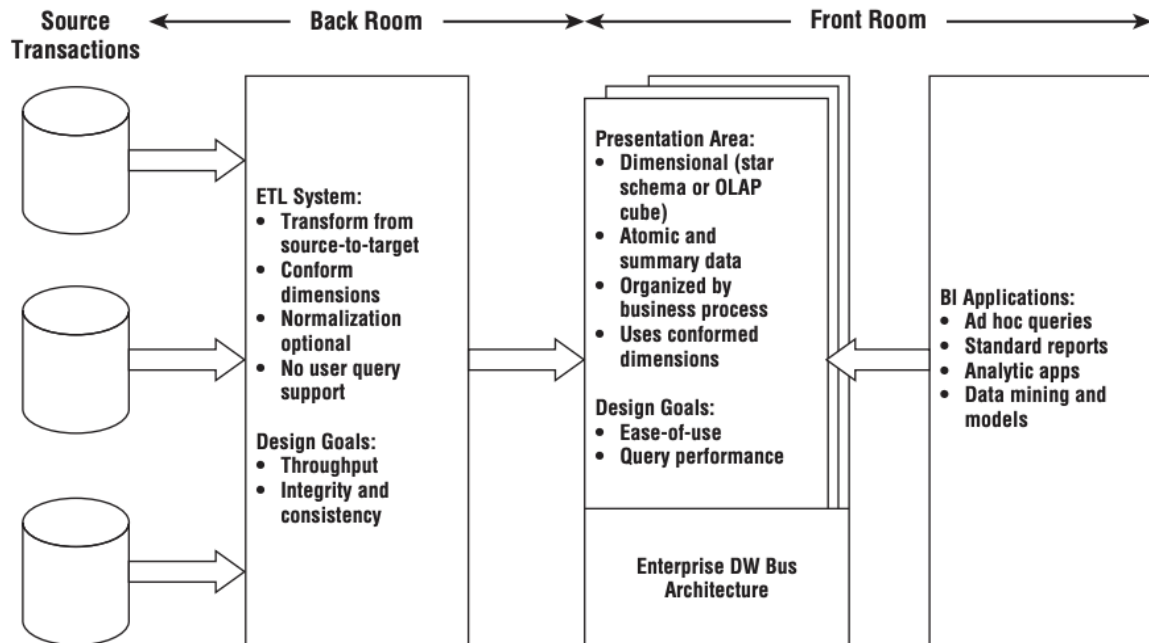


Figure 6- Core elements of the Kimball DW/BI architecture (Kimball & Ross, 2013)

The processing performance and the availability are the main priorities in the operational source systems. The data can be collected from different sources, internal and external. Internal data is stored in the operational systems inside an organization like HR, CRM, ERP systems. External data sources refer to the one collected outside an organization, internet, governments, other institutions (Ong et al., 2011).

ETL Systems have three main processes (Ong et al., 2011):

- Extract: identify and collect relevant data from different sources.
- Transform: covert data according to the business rules into consistent formats for reporting and analysis.
- Load: load the transformed data into the target repository

Presentation area and BI applications are the final major component, and where the value of this process is achieved. BI applications speed up information analysis and performance evaluation to help companies reduce inefficiencies, flag potential problems and identify areas of future growth. Before these tools, data analysis was needed more time and effort, but BI tools are used to automate many of the processes (Microsoft, 2021).

4.3.2. Self-Service BI

According to Gartner (2021), self-service BI (SSBI) is defined as a tool where end-users can design and deploy their own reports and analyses within a solid structure and BI architecture (Gartner, 2021).

The main objective of Self-service BI is to make BI tools easy to use, make it easy to access source data, make DW solutions fast to deploy and easy to manage and make BI results easy to consume and enhance (Imhoff & White, 2011).

SSBI allows business users and analysts to be more involved in their own data analytics, focusing in the support of end users (Tableau, 2021) and the benefits of this approach are based in a single version of truth, the reduced dependency on IT and MIS teams, the cost cutting, the increased flexibility and the effortless Decision-Making (Acuvate, 2021).

4.3.3. Data Visualization

Data visualization is not a modern development in statistics. In fact, map-making, and later, cartography and statistic graphics have been used for a long time. Developments in technologies and other sciences like mathematical theory and practice, enabled the general use of graphics (Friendly, 2008).

Recent recent definitions say that data visualization involves more than just representing data in a graphical form, because the data should be revealed in a good display and should add value to the analysis (Chen et al., 2007).

Dashboards feature the most important information needed for a purpose on a single screen through visual displays (Smith, 2013). They allow users to visualize data but are only useful if they support them to fulfill their goals (Janes et al., 2013).

Richard Brath and Michael Peters (2004) claim that “Effective design is crucial for dashboards” because the key information needs to be clear and. These tools help people visually identify patterns, trends and anomalies and guide them in the decision-making process (Brath & Peters, 2004).

The acronym S.M.A.R.T. is what characterizes a Dashboard, according to Malik (Malik, 2005):

- **S** stands for “Synergetic” which means that it should be effective in a way that it contributes to the user with the information displayed in each screen.
- **M** means “Monitor KPIs” because key performance indicators are crucial for decision-making and should be in spotlight.
- **A** is for “Accurate”, to transmit confidence to the end user, the information should be precise.
- **R** means “Responsive”, the dashboard should respond to the predefined needs and draw attention to critical matters through alerts, emails or other forms.
- **T** stands for “Timely” because the information presented should always be up to date for effective decision-making

While building a dashboard, there are a few mistakes that should be avoided, these stand out: overly involved dashboard, too many or too large visualizations on a single dashboard, unclear language, many different types of information in one visual, not using the appropriate visualization and having insufficient labelled data (Datore, 2020).

In summary, one dashboard is an application with a collection of metrics, goals, results and alerts presented in a visually effective manner (Malik, 2005).

5. CONCEPTUAL APPROACH

5.1. CONTEXT

In this chapter, the developed conceptual model under the Research Design Methodology is presented and the complete process flow from the data collection until the data visualization is explained with a suggested data model aligned with the goal of the project, to show the contributions from one institution to the SDGs in a dashboard, fulfilling all BI concepts and requirements taking in account education, projects, thesis, publications and investigation.

To finalize the conceptual proposal, several dashboard pages will be designed and presented, in a way that the final output will provide the right visualizations and conclusions that the institution needs for a better performance.

5.2. DATA FLOW

The data used in this project will be provided by the institution in an excel format, and it is expected one excel per subject (5) as data sources. After all data collected, some transformations, cleansing and formatting in the documents structure will be applied in Microsoft Excel and subsequently in Power Query inside Power BI Desktop when the connections are established between the data and the software in a logical form.

The expected model for this data sources will be a constellation schema, to analyze several fact tables sharing the same dimensions and lastly the data visualizations will be designed in Power BI Desktop and made available in Power BI Service for the institution exploration.

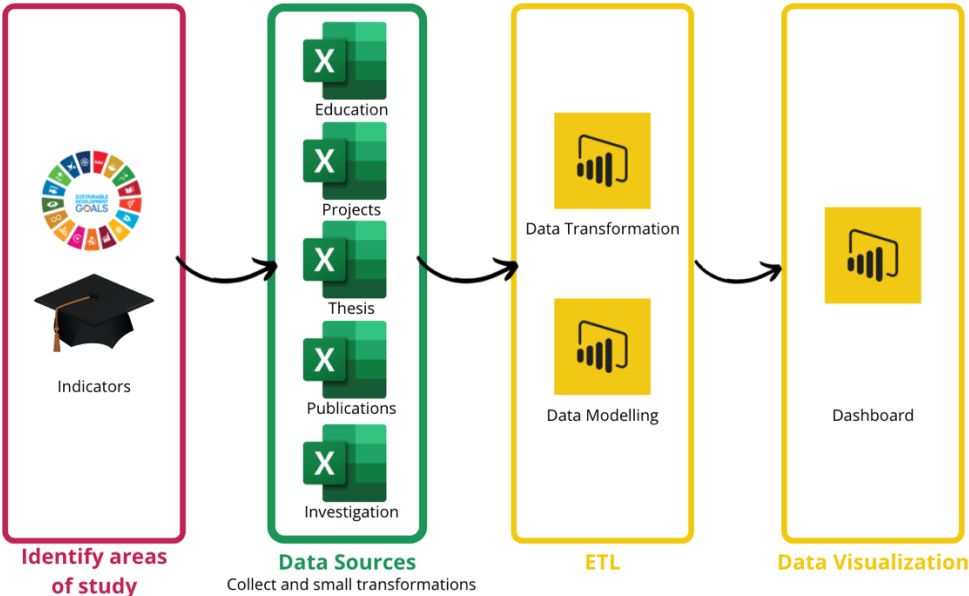


Figure 7- Project Flow

5.3. CONCEPTUAL DIMENSIONAL MODEL

The proposed model is composed by five fact tables being the 5 areas of study (education, projects, thesis, publications and investigation) and three dimensional tables (date, SDGs and organic unit) that will allow the categorization of the events in the facts.

The interaction between this tables will result in a Constellation Schema. The fact tables are going to be study under the same dimensions and because of that the dimension tables are going to be shared among the fact ones, represented in the figure below.

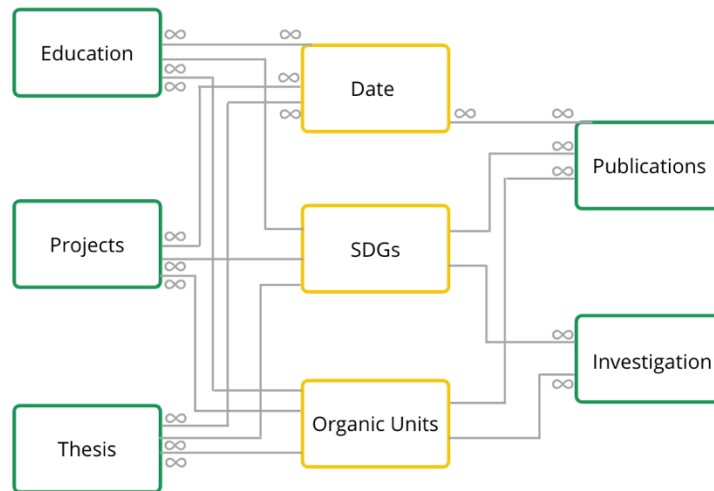


Figure 8- Conceptual Dimensional Model

5.4. DATA TABLE STRUCTURE

The objective of identifying the data needed for the right model structure involves realizing the information that must be present in the tables of each area of analysis, showed in the sub-topics below.

5.4.1. Projects

Organic Unit	Project Name	Supervisor	Start Date	End Date	SD	SD	SD	SD	SD	SD	SD	SD	SD	SD	SD	SD	SD	SD	SD	SD	SD	SD
					G 1	G 2	G 3	G 4	G 5	G 6	G 7	G 8	G 9	G 10	G 11	G 12	G 13	G 14	G 15	G 16	G 17	
NOVA IMS	Consultoria para Inovação da AML	Vitor Santos	2019	2022									1	1	1	1						1
NOVA IMS	Ciência dos Dados de Energia - ADENE	Vitor Santos	2020	2021							1					1	1					

Figure 9- Projects table

5.4.2. Education

Organic Unit	Scholar Year	Category	Course	Year	Semester	Curricular Unit	Teacher	E-mail	SDG
NOVA IMS	2021	Bachelor	Licenciatura em Gestão de Informação	1.º	Outono	Gestão Empresarial	Carlos Tam	email	SDG 8
NOVA IMS	2021	Bachelor	Licenciatura em Gestão de Informação	1.º	Outono	Gestão Empresarial	Carlos Tam	email	SDG 9
NOVA IMS	2021	Bachelor	Licenciatura em Gestão de Informação	1.º	Outono	Sistemas de Informação	Maria Manuela Simões Aparício da Costa	email	SDG 4

Figure 10- Education table

5.4.3. Thesis

Organic Unit	Year	Course	Specialization	Type	Thesis Title	Supervisor	SDG
NOVA IMS	2020	TAA	Ramo Comum	Trabalho de projecto	Time series forecasting applied to an energy management system - A comparison between Deep Learning Models and other Machine Learning Models	Mauro Castelli	12
NOVA IMS	2020	TGI	Marketing Intelligence	Dissertação	Altruism and culture as drivers for circular economy engagement	Diego Costa Pinto	7

Figure 11- Thesis table

5.4.4. Publications

Organic Unit	Year	Teacher	Publication	Type	National	SDG
NOVA IMS	2020	Felipe Siqueira e Campos	Lourenço-de-Moraes, R. (2020). Journal of Biogeography. Functional traits explain amphibian distribution in the Brazilian Atlantic Forest. https://doi.org/10.1111/jbi.13727	Article	Internacional	15
NOVA IMS	2021	Ian James Scott	Scott, I. J., Carvalho, P. M. S., Botterud, A., & Silva, C. A. (2021). Long-term uncertainties in generation expansion planning: Implications for electricity market modelling and policy. Energy, 227(Julho), 1-12. [120371]. https://doi.org/10.1016/j.energy.2021.120371	Article	Internacional	7

Figure 12- Publications table

5.4.5. Investigation

Organic Unit	Labs	SDG 1	SDG 2	SDG 3	SDG 4	SDG 5	SDG 6	SDG 7	SDG 8	SDG 9	SDG 10	SDG 11	SDG 12	SDG 13	SDG 14	SDG 15	SDG 16	SDG 17
NOVA IMS	NOVA Marketing Analytics Lab		1	1					1				1					1

Figure 13- Investigation table

5.5. DIMENSIONS

- Dim_Date: date data according with the Portuguese calendar;
- Dim_SDG: SDG list with the correspondent Group, short and long description;
- Dim_OrganicUnit: data regarding the Organic Units of the institution;

5.6. FACTS

- Fact_Education: data regarding the curricular Units by year of teaching of the institution with the responsible professor and respective SDG;
- Fact_Projects: list of the elaborated projects elaborated in the institution by year and responsible professor with the assigned SDGs;
- Fact_Thesis: records of all thesis done in the institution and the respective supervisor, year and SDG;
- Fact_Publications: list of the elaborated publications elaborated in the institution by year and responsible professor with the assigned SDGs;
- Fact_Investigation: records of all the institution Labs with the assigned SDGs;

5.7. MEASURES AND KPIS

- Education Contribution: Count of all contributions from the Education table;
- Education Contribution (%): Count of all contributions from the Education table / all records from the Education table;
- Projects Contribution: Count of all contributions from the Projects table;
- Projects Contribution (%): Count of all contributions from the Projects table / all records from the Projects table;
- Thesis Contribution: Count of all contributions from the Thesis table;
- Publications Contribution: Count of all contributions from the Publications table;
- Investigation Contribution: Count of all contributions from the Investigation table;
- Investigation Contribution (%): Count of all contributions from the Investigation table / all records from the Investigation table;
- Overall Contribution: Sum of all contributions from Education, Projects, Thesis, Publications and Investigation;

5.8. DASHBOARD MOCKUPS

The project will contain nine dashboards following the good practices presented in the literature review. Below there are two mockups of the dashboards, the overall contributions to the SDGs from all areas of the institution and the contributions from projects more detailed.

Figure 14 shows the dashboard page where a summary of all SDGs is presented, and the contribution values are showed per area of study. Below there is a bar chart that will allow the end user to know the institution positioning regarding the SDGs and take action in the ones with less contributions. There is also one filter pane that allows year selection.

The mockup for the projects dashboard (Figure 15) permit the user to select, using the different filter panes, the year (filter on top of the page) and the SDG and respective group (left side of the page) to see the information that suits better the needs. The information will be presented in two KPIS on top of the page to highlight the important indicators, in one donut chart that allows to see the distribution of the projects per SDG, one table for detailed information regarding the drill-down to year, supervisor and project name, and finally one bar chart to see the evolution of the projects contribution per year.

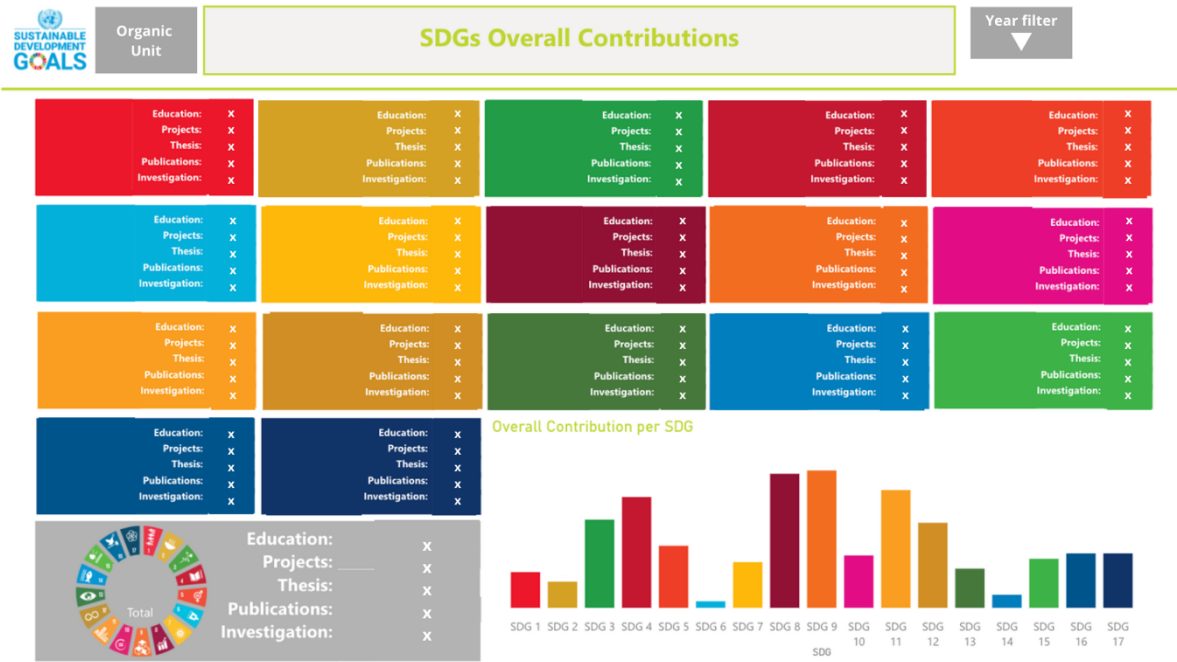


Figure 14- SDGs Overall Contributions Mockup

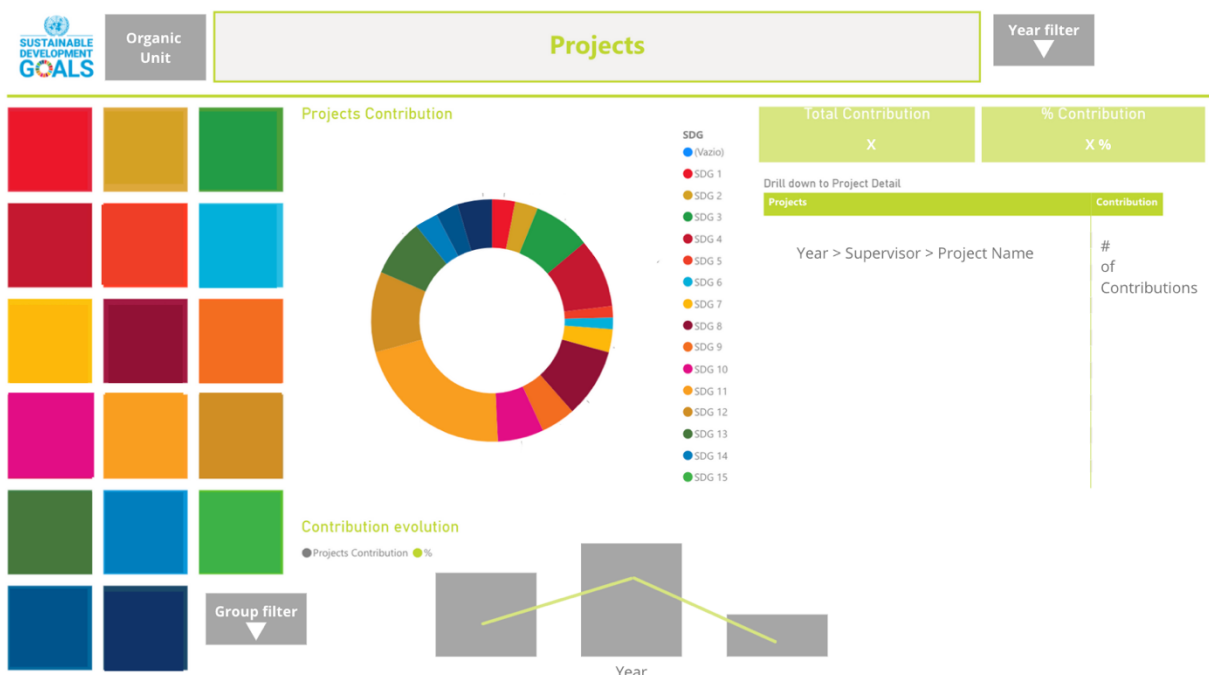


Figure 15- Education Contributions Mockup

6. ELABORATED WORK

6.1. DATA MODEL

To understand better every process, makes sense to know how the data is related in order to fulfill the objective of this project. The schema for this analysis is a constellation schema and consists in several fact tables sharing one or more dimensional tables (more than one star schema at a time).

The constellation schema includes five fact tables and three dimensional tables as described below:

- **Fact_Publications:** this information is provided by a Nova IMS database where the articles are stored per date and the related SDG is associated.
- **Fact_Projects:** this information is provided by a Nova IMS database where the projects are stored per date and the related SDG is associated.
- **Fact_Thesis:** this information is provided by a Nova IMS database where the thesis are stored per date and the related SDG is associated.
- **Fact_Investigation:** this information is provided by a Nova IMS database where the articles are stored with the related SDG is associated.
- **Fact_Education:** a survey was done to the teachers at Nova IMS, to understand what the best relation of the SDGs and their course units is.

The three dimensional tables include unique attributes that allow to classify the data:

- **Dim_Date:** it is a calendar dimension and will allow to filter/analyze the data per year.
- **Dim_SDG:** a list of all SDGs, a brief description and the group of the SDG.
- **Dim_UnidadesOrganicas:** a list of all Organic Units.

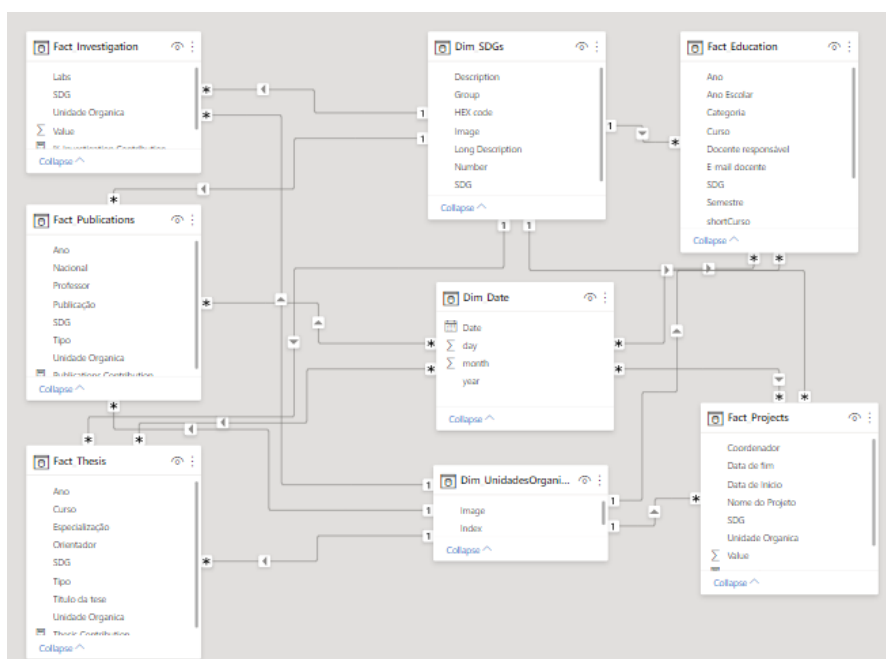


Figure 16- Power BI Data model

The relations between the tables in the constellation schema are:

- Dim_Date[Year] → Fact_Projects[Data de Início]
- Dim_Date[Year] → Fact_Publications[Ano]
- Dim_Date[Year] → Fact_Thesis[Ano]
- Dim_Date[Year] → Fact_Education [Ano Escolar]
- Dim_SDGs[SDG] → Fact_Projects[SDG]
- Dim_SDGs[SDG] → Fact_Education[SDG]
- Dim_SDGs[SDG] → Fact_Investigation[SDG]
- Dim_SDGs[Number] → Fact_Thesis[SDG]
- Dim_SDGs[Number] → Fact_Publications[SDG]
- Dim_UnidadesOrganicas[Unidades Organicas] → Fact_Publications[Unidade Organica]
- Dim_UnidadesOrganicas[Unidades Organicas] → Fact_Education[Unidade Organica]
- Dim_UnidadesOrganicas[Unidades Organicas] → Fact_Projects[Unidade Organica]
- Dim_UnidadesOrganicas[Unidades Organicas] → Fact_Thesis[Unidade Organica]
- Dim_UnidadesOrganicas[Unidades Organicas] → Fact_Investigation[Unidade Organica]

6.2. DATA COLLECTION AND DATA SOURCES

This project is related to Nova IMS, and because of that most of the data is provided by the institution and other is collected with them.

6.2.1. Fact_Projects

The data for this fact table is provided by Nova IMS and is structured in an excel file with the following fields:

- Name of the project;
- Supervisor;
- Start Date;
- End Date;
- Related SDGs (filled with “X”).

Nome do Projeto	Coordenador	Data de Início			Data de Término			ODS 1 - Erradicação da pobreza	ODS 2 - Saúde de qualidade	ODS 3 - Educação de qualidade	ODS 4 - Igualdade de Género	ODS 5 - Água Potável e Saneamento	ODS 7 - Energia limpa e acessível	ODS 8 - Trabalho Decente e Crescimento	ODS 9 - Indústria, Inovação e Infraestruturas	ODS 10 - Redução das Desigualdades	ODS 11 - Cidades e Comunidades Sustentáveis	ODS 12 - Produção e Consumo Sustentáveis	ODS 13 - Ação Climática	ODS 14 - Vida Marinha	ODS 15 - Vida Terrestre	ODS 16 - Paz, Justiça e Fortes Instituições	ODS 17 - Parcerias para a Implementação dos ODS	
		Dia	Mês	Ano	Dia	Mês	Ano																	
Estudo de Efeitos Práticos e Condições de Construção de Plataforma de Gestão de Informação Necessária à Operação de Inteligência na Gestão do Território Nacional (Sistema Operacional de Gestão de Territórios Inteligentes - SOTI)	Miguel Neto	1	10	2019	31	7	2020										X							
Apoio de Serviços de Consultoria Técnica na Área dos Métodos Avançados para Cálculo das Esferas de Atuação de Vida Económica de Tabaco: Complexos de Atividade Económica e Produtiva, em Contexto de Implementação dos Direitos Associados à Produção no Âmbito do SEC 2001, e dos Métodos Estatísticos e Demográficos e de Inovação e Produção Demográficas	Jorge Ribeiro	1	1	2019	31	12	2019																	
Prestação de Serviços de Avaliação Técnica e Científica no âmbito da Implementação de Planos de Gestão Ambientais para a Cidade de Lisboa (ICGP - Compromisso para a Sustentabilidade)	Miguel Neto	1	1	2017	7	7	2017											X					X	
ICGP - Compromisso para a Sustentabilidade	Miguel Neto	1	1	2017	7	7	2017											X						
ICGP - Compromisso para a Sustentabilidade	Miguel Neto	1	1	2017	7	7	2017											X						

Figure 17- Project data provided by Nova IMS

To use this data as an input for the project, some data cleansing was made, and the final input has the following fields:

- Name of the project;
- Supervisor;
- Start Year (2019, 2020, 2021);
- End Year;
- Related SDGs (filled with “1”).

Unidade Organiza	Nome do Projeto	Coordenador	Data de Início	Data de fim	SDG 1	SDG 2	SDG 3	SDG 4	SDG 5	SDG 6	SDG 7	SDG 8	SDG 9	SDG 10	SDG 11	SDG 12	SDG 13	SDG 14	SDG 15	SDG 16	SDG 17	
NOVA IMS	INSP - (Compromisso para a Excelência)	Miguel Neto	2020	2021													1					
NOVA IMS	INSP Data+	Miguel Neto	2020	2020													1					
NOVA IMS	ADA - Avaliação de Impacto e Inteligência Artificial	Pedro Simões Coelho	2019	2021																		
NOVA IMS	Aquisição de Serviços Adicionais ao SPACCE	Miguel Neto	2020	2021																		
NOVA IMS	Aquisição de serviços de consultoria especializada para elaboração, desenvolvimento e implementação de uma estratégia de inovação para a Área Metropolitana de Lisboa (AMNL)	Vitor Santos	2019	2022								1	1	1	1							1
NOVA IMS	Dados Abertos: Diferença	Miguel Neto	2021	2022																		1
NOVA IMS	Aquisição de serviços de consultoria técnica na área dos métodos atuais, para cálculo das esperanças médias de vida decorrentes de ráguas completas de mortalidade contemporâneas e prospectivas e na valorização dos direitos associados a pensões no âmbito do SEC 2010, e dos métodos estatísticos e demográficos a aplicar às estimativas e projeções demográficas	Jorge Bravo	2020	2020			1		1				1									
NOVA IMS	Desafio de Gestão: Inteligência em Gestão de Sistemas	Roberto Henriques	2020	2020																		
NOVA IMS	Avaliação de Satisfação dos Clientes do IPG - 2019	Pedro Simões Coelho	2020	2020																		
NOVA IMS	Ciência dos Dados de Energia - ACENE	Vitor Santos	2020	2021								1				1	1					

Figure 18- Project data input structure

6.2.2. Fact_Education

The university provided an excel file containing the course, year, semester, and responsible professor for each Curricular Unit, but to have the SDGs associated, one small survey was made to each responsible professor.

The survey allows each professor to select their name and then select what SDGs relate best with the Curricular Units they have, based on a brief description of each one.

Course Units Contributing for the Sustainable Development Goals achievement

Welcome to the survey about the Course Units contribution at Nova IMS for the Sustainable Development Goals (SDGs) achievement.

The survey will be about 5 minutes and will help to develop one business intelligence master project to measure quantitatively the NOVA IMS contribution to 17 interlinked global goals designed to be a "blueprint to achieve a better and more sustainable future for all".

There is no right or wrong answers. Data will be only analyzed for this specific master project.

Thank you very much!

***Obrigatório**

Please select your name: *

Selecionar

Seguinte

SDG 15 - Life on land (Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation and halt biodiversity loss)

SDG 16 - Peace, justice and strong institutions (Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels)

SDG 17 - Partnerships for the goals (Strengthen the means of implementation and revitalize the global partnership for sustainable development)

For more information: <https://sdgs.un.org/goals>

Please select the SDGs more suitable to each Curricular Unit according to the brief description above.

SDG 1 SDG 2 SDG 3 SDG 4 SDG 5 SDG 6 SDG 7 SDG 8 SDG 9

GI - Cidades Inteligentes e Sustentáveis

STI - Cidades Inteligentes e Sustentáveis

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Figure 19- Curricular Units-SDGs survey

The input file for the project has the following structure:

A	B	C	D	E	F	G	H	I	J
Unidade Organiz	Ano Escolar	Categoria	Curso	Ano	Semestr	Unidade Curricular	Docente responsável	E-mail	SDG
NOVA IMS	2021	Bachelor	Licenciatura em Gestão de Informação	1.º	Outono	Gestão Empresarial	Carlos Tam	carlos@novaims.pt	SDG 8
NOVA IMS	2021	Bachelor	Licenciatura em Gestão de Informação	1.º	Outono	Gestão Empresarial	Carlos Tam	carlos@novaims.pt	SDG 9
NOVA IMS	2021	Bachelor	Licenciatura em Gestão de Informação	1.º	Outono	Sistemas de Informação	Maria Manuela Simões Apar	mcosta@novaims.pt	SDG 4
NOVA IMS	2021	Bachelor	Licenciatura em Gestão de Informação	1.º	Outono	Sistemas de Informação	Maria Manuela Simões Apar	mcosta@novaims.pt	SDG 5
NOVA IMS	2021	Bachelor	Licenciatura em Gestão de Informação	1.º	Outono	Sistemas de Informação	Maria Manuela Simões Apar	mcosta@novaims.pt	SDG 8
NOVA IMS	2021	Bachelor	Licenciatura em Gestão de Informação	1.º	Outono	Sistemas de Informação	Maria Manuela Simões Apar	mcosta@novaims.pt	SDG 9
NOVA IMS	2021	Bachelor	Licenciatura em Gestão de Informação	1.º	Outono	Sistemas de Informação	Maria Manuela Simões Apar	mcosta@novaims.pt	SDG 11
NOVA IMS	2021	Bachelor	Licenciatura em Gestão de Informação	1.º	Outono	Sistemas de Informação	Maria Manuela Simões Apar	mcosta@novaims.pt	SDG 16
NOVA IMS	2021	Bachelor	Licenciatura em Gestão de Informação	1.º	Primavera	Computação em Estatística e Gestão de In	Frederico Miguel Campos Cr	fesus@novaims.pt	SDG 16
NOVA IMS	2021	Bachelor	Licenciatura em Gestão de Informação	1.º	Primavera	Desenvolvimento Pessoal I	Marco Octávio Trindade Pain	painho@novaims.pt	SDG 16
NOVA IMS	2021	Bachelor	Licenciatura em Gestão de Informação	1.º	Primavera	Desenvolvimento Pessoal I	Marco Octávio Trindade Pain	painho@novaims.pt	SDG 5
NOVA IMS	2021	Bachelor	Licenciatura em Gestão de Informação	1.º	Primavera	Estatística I	Ana Cristina Marinho da Cost	acosta@novaims.pt	SDG 4

Figure 20- Curricular Units input file

6.2.3. Fact_Publications

A two-sheet excel file was provided by Nova IMS. Each sheet corresponds to the 2 years of analysis (2020 and 2021), and the file contains several details: the professors name, the students name, the divulgation date, the name and type of publication, if it is national or international and finally the related SDGs:

Docente 1	Docente 2	Docentes externos ao MagIc	Alunos	Divulgação	Publicação	Tipo	Tipo - PURE	Nacional/Internacional	SDGs
Jorge Bravo			richard chamboko (d2014188) <D2014188@novaims.unl.pt>	29-06-2020	Chamboko, R., & Bravo, J. M. (2020). A multi-state approach to modelling intermediate events and multiple mortgage loan outcomes. <i>Risks</i> , 8(2), 1-29. [64]. https://doi.org/10.3390/risks8020064	Publicação em Periódicos Científicos	Article	Internacional	SDG 8 - Decent work and economic growth
Marco Painho				29-06-2020	Perazzoni, F., Bacelar-Nicolau, P., & Painho, M. (2020). Geointelligence against illegal deforestation and timber laundering in the Brazilian Amazon. <i>ISPRS International Journal of Geo-Information</i> , 9(6), 1-29. [398]. https://doi.org/10.3390/ijgi9060398	Publicação em Periódicos Científicos	Article	Internacional	SDG 12 - Responsible production and consumption

Figure 21- Publications data provided by Nova IMS

To use this data as an input for the project, some data cleansing was made, and the final input has the following fields:

- Year;
- Professor;
- Publication name;
- Type of publication;
- National/International column;
- Related SDG (just the number associated).

Unidade Organica	Ano	Professor	Publicação	Tipo	Nacional	SDG
NOVA IMS	2020	Maria Manuela A	Pedrosa, I., Cost	Article	Internac	8
NOVA IMS	2020	Maria Manuela A	Pedrosa, I., Cost	Article	Internac	9
NOVA IMS	2020	Diego Costa Pint	Costa Pinto, D.,	Article	Internac	5
NOVA IMS	2020	Diego Costa Pint	Costa Pinto, D.,	Article	Internac	8
NOVA IMS	2020	Diego Costa Pint	Costa Pinto, D.,	Article	Internac	10
NOVA IMS	2020	Felipe Siqueira	Lourenço-de-M	Article	Internac	15
NOVA IMS	2020	Pedro Cabral;Fe	Campos, F. S., L	Article	Internac	13
NOVA IMS	2020	Pedro Cabral;Fe	Campos, F. S., L	Article	Internac	15
NOVA IMS	2020	Manuela Aparíci	Fernandes, N.,	Article	Internac	8
NOVA IMS	2020	Manuela Aparíci	Fernandes, N.,	Article	Internac	9
NOVA IMS	2020	Manuela Aparíci	Fernandes, N.,	Article	Internac	11
NOVA IMS	2020	Devanjan Bhatta	Trilles, S., Grane	Article	Internac	9

Figure 22- Publications data input structure

6.2.4. Fact_Thesis

A two-sheet excel file was provided by Nova IMS. Each sheet corresponds to the 2 years of analysis (2020 and 2021), and the file contains several details: Course ID, Specialization, Type of thesis, Title, Supervisor and the related SDGs.

Identificação do Curso	Especialização	Especialização Inglês	Tipo	Título	Orientadores	SDGs
TEGI	Análise e Gestão de Risco	Risk Analysis and Management	Dissertação	Forecasting sovereign bonds markets using machine learning: forecasting the portuguese government bond using machine learning approach	Mauro Castelli	SDG 8 - Decent work and economic growth
TEGI	Estudos de Mercado e Gestão de Relacionamento com o Cliente	Marketing Research and CRM	Dissertação	The effect of hybridisation processes on stakeholder trust in non-profit and hybrid organisations: How stakeholder trust is influenced by the integration of market practices in non-profit organisations	Jorge Morais Mendes	SDG 8 - Decent work and economic growth SDG 17 - Partnerships for the goals

Figure 23 Thesis data provided by Nova IMS

To use this data as an input for the project, some data cleansing was made, and the final input has the same fields but the related SDG is filled with just the number associated:

Unidade Organica	Ano	Curso	Especialização	Tipo	Título da tese	Orientador	SDG
NOVA IMS	2020	TAA	Ramo Comum	Trabalho de projecto	Time series fo	Mauro Cast	12
NOVA IMS	2020	TGI	Marketing Intelligence	Dissertação	Altruism and c	Diego Costa	7
NOVA IMS	2020	TGI	Marketing Intelligence	Dissertação	Altruism and c	Diego Costa	12
NOVA IMS	2020	TGI	Knowledge Management and Bus	Dissertação	Development	Jorge Morai	3
NOVA IMS	2020	TGI	Information Systems and Technol	Dissertação	The role of eni	Tiago André	7
NOVA IMS	2020	TGI	Information Systems and Technol	Dissertação	Energy produc	Aleš Groznil	7
NOVA IMS	2020	TGI	Information Systems and Technol	Dissertação	Energy produc	Aleš Groznil	13
NOVA IMS	2021	TEGI	Risk Analysis and Management	Dissertação	Forecasting so	Mauro Cast	8
NOVA IMS	2021	TEGI	Marketing Research and CRM	Dissertação	The effect of h	Jorge Morai	8
NOVA IMS	2021	TEGI	Marketing Research and CRM	Dissertação	The effect of h	Jorge Morai	17
NOVA IMS	2021	TGEO	Ramo Comum	Dissertação	Modeling the	Edzer Pebes	3
NOVA IMS	2021	TGEO	Ramo Comum	Dissertação	Enhancing tem	Filiberto Pla	2
NOVA IMS	2021	TGEO	Ramo Comum	Dissertação	Enhancing tem	Filiberto Pla	3

Figure 24- Thesis data input structure

6.2.5. Fact_Investigation

The data for this fact table is provided by Nova IMS and is structured in an excel file with the different lab names and the associated SDGs marked with an X.

Labs	ODS 1 - Erradicar a pobreza	ODS 2 - Erradicar a fome	ODS 3 - Saúde de qualidade	ODS 4 - Educação de qualidade	ODS 5 - Igualdade de Género	ODS 6 - Água Potável e Saneamento	ODS 7 - Energias Renováveis e Acessíveis	ODS 8 - Trabalho Digno e Crescimento Económico	ODS 9 - Indústria, Inovação e Infraestruturas	ODS 10 - Reduzir as Desigualdades	ODS 11 - Cidades e Comunidades Sustentáveis	ODS 12 - Produção e Consumo Sustentáveis	ODS 13 - Ação Climática	ODS 14 - Proteger a Vida Marinha	ODS 15 - Proteger a Vida Terrestre	ODS 16 - Paz, Justiça e Instituições Eficazes	ODS 17 - Parcerias para a Implementação dos Objetivos
NOVA Marketing Analytics Lab		x	x					x				x					x
NOVA Data Analytics Lab																	
NOVA Geoinformatics & Analytics Lab			x	x					x		x			x	x		
NOVA Information Systems & Analytics Lab	x		x	x			x	x	x		x	x	x				x
NOVA Health & Analytics Lab	x			x				x	x	x						x	x
NOVA Urban Analytics Lab			x			x	x	x				x	x		x		
NOVA Innovation & Analytics Lab	x		x	x			x	x	x			x				x	x

Figure 25- Investigation data provided by Nova IMS

To use this data as an input for the project, some data cleansing was made, and the final input has the SDG titles simplified and the associated SDGs marked with "1".

Unidade Organica	Labs	SDG 1	SDG 2	SDG 3	SDG 4	SDG 5	SDG 6	SDG 7	SDG 8	SDG 9	SDG 10	SDG 11	SDG 12	SDG 13	SDG 14	SDG 15	SDG 16	SDG 17
NOVA IMS	NOVA Marketing Analytics Lab		1	1					1				1					1
NOVA IMS	NOVA Data Analytics Lab																	
NOVA IMS	NOVA Geoinformatics & Analytics Lab			1	1					1		1			1	1		
NOVA IMS	NOVA Information Systems & Analytics Lab	1		1	1			1	1	1		1	1	1				1
NOVA IMS	NOVA Health & Analytics Lab	1		1	1				1	1	1	1					1	1
NOVA IMS	NOVA Urban Analytics Lab			1			1	1	1	1		1	1	1			1	
NOVA IMS	NOVA Innovation & Analytics Lab	1			1			1	1	1	1		1				1	1

Figure 26- Investigation data input structure

6.2.6. Dim_Date

This dimensional table is created using DAX in Power BI Desktop.

```
Dim_Date =
GENERATE (
    CALENDAR ( DATE ( 2019, 1, 1 ), DATE ( 2021, 12, 31 ) ),
    VAR currentDate = [Date]
    VAR day = DAY ( currentDate )
    VAR month = MONTH ( currentDate )
    VAR year = YEAR ( currentDate )
    RETURN ROW (
        "day", day,
        "month", month,
        "year", year )
)
```

Figure 27- Dim_Date DAX code

6.2.7. Dim_SDGs

The source for this dimension is an excel file, made for the purpose of this project, with the following fields:

SDG	Number	Group	Description	Long Description	Image	HEX code
SDG 1	1	People	No poverty	End poverty in all its forms everywhere	https://www.unl.pt/sites/default/files/e-web-goal-01_0.png	#EC1629
SDG 2	2	People	Zero hunger	End hunger, achieve food security and improved	https://www.unl.pt/sites/default/files/e-web-goal-02.png	#D4A124
SDG 3	3	People	Good health and well-being	Ensure healthy lives and promote well-being for all	https://www.unl.pt/sites/default/files/e-web-goal-03.png	#229C46
SDG 4	4	People	Quality education	Ensure inclusive and equitable quality education	https://www.unl.pt/sites/default/files/e-web-goal-04.png	#C41930
SDG 5	5	People	Gender equality	Achieve gender equality and empower all women	https://www.unl.pt/sites/default/files/e-web-goal-05.png	#EF3E27
SDG 6	6	Planet	Clean water and sanitation	Ensure availability and sustainable management of	https://www.unl.pt/sites/default/files/e-web-goal-06.png	#00B0DA
SDG 7	7	Prosperity	Affordable and clean energy	Ensure access to affordable, reliable, sustainable	https://www.unl.pt/sites/default/files/e-web-goal-07.png	#FDB808
SDG 8	8	Prosperity	Decent work and economic growth	Promote sustained, inclusive and sustainable	https://www.unl.pt/sites/default/files/e-web-goal-08.png	#901135
SDG 9	9	Prosperity	Industry, innovation and infrastructure	Build resilient infrastructures, promote inclusive	https://www.unl.pt/sites/default/files/e-web-goal-09.png	#F36D20
SDG 10	10	Prosperity	Reduced inequalities	Reduce inequality within and among countries	https://www.unl.pt/sites/default/files/e-web-goal-10.png	#E20C85
SDG 11	11	Prosperity	Sustainable cities and communities	Make cities and human settlements inclusive, safe,	https://www.unl.pt/sites/default/files/e-web-goal-11.png	#F99E21
SDG 12	12	Planet	Responsible consumption and production	Ensure sustainable consumption and production	https://www.unl.pt/sites/default/files/e-web-goal-12.png	#D08E25
SDG 13	13	Planet	Climate action	Take urgent action to combat climate change and its	https://www.unl.pt/sites/default/files/e-web-goal-13.png	#46783C
SDG 14	14	Planet	Life below water	Conserve and sustainably use the oceans, seas and	https://www.unl.pt/sites/default/files/e-web-goal-14.png	#007EBD
SDG 15	15	Planet	Life on land	Protect, restore and promote sustainable use of	https://www.unl.pt/sites/default/files/e-web-goal-15.png	#3CB247
SDG 16	16	Peace	Peace, justice and strong institutions	Promote peaceful and inclusive societies for	https://www.unl.pt/sites/default/files/e-web-goal-16.png	#00548C
SDG 17	17	Partnership	Partnerships for the goals	Strengthen the means of implementation and	https://www.unl.pt/sites/default/files/e-web-goal-17.png	#113368

Figure 28- Dim_SDGs input

6.2.8. Dim_UnidadesOrganicas

This dimension was created to enable the University to expand the project to other Organic Units inside NOVA.

The source for this dimension is an excel file, made for the purpose of this project, with the following fields:

Index	Unidade Organica	Image
1	NOVA IMS	https://m
2	ITQB NOVA	data:imag
3	NOVA SCHOOL OF LAW	https://w
4	NOVA MEDICAL SCHO	https://yt
5	NOVA SBE	https://w
6	NOVA FCSH	https://m
7	NOVA FCT	https://w

Figure 29- Dim_UnidadesOrganicas input

6.3. DATA CLEANSING AND TRANSFORMATION

In this step of the project, some transformations were made in Power Query to make the data fill the requirements for the implementation.

6.3.1. Fact_Projects

To structure this input file the following steps were made in Power Query editor:

- Fill with “0” the SDGs columns that were blank;
- Unpivot table function was applied in all columns except the SDGs related ones;
- The new Attribute column was renamed to “SDG”.

Unidade Organica	Nome do Projeto	Coordenador	Data de Inicio	Data de fim	SDG	Value
NOVA IMS	IVDP + (Compromisso para a ...	Miguel Neto	2020	2021	SDG 1	0
NOVA IMS	IVDP + (Compromisso para a ...	Miguel Neto	2020	2021	SDG 2	0
NOVA IMS	IVDP + (Compromisso para a ...	Miguel Neto	2020	2021	SDG 3	0
NOVA IMS	IVDP + (Compromisso para a ...	Miguel Neto	2020	2021	SDG 4	0
NOVA IMS	IVDP + (Compromisso para a ...	Miguel Neto	2020	2021	SDG 5	0
NOVA IMS	IVDP + (Compromisso para a ...	Miguel Neto	2020	2021	SDG 6	0
NOVA IMS	IVDP + (Compromisso para a ...	Miguel Neto	2020	2021	SDG 7	0
NOVA IMS	IVDP + (Compromisso para a ...	Miguel Neto	2020	2021	SDG 8	0
NOVA IMS	IVDP + (Compromisso para a ...	Miguel Neto	2020	2021	SDG 9	0
NOVA IMS	IVDP + (Compromisso para a ...	Miguel Neto	2020	2021	SDG 10	0
NOVA IMS	IVDP + (Compromisso para a ...	Miguel Neto	2020	2021	SDG 11	0
NOVA IMS	IVDP + (Compromisso para a ...	Miguel Neto	2020	2021	SDG 12	1
NOVA IMS	IVDP + (Compromisso para a ...	Miguel Neto	2020	2021	SDG 13	0

Figure 30- Fact_Projects final structure

6.3.2. Fact_Education

To structure this input file the following steps were made in Power Query editor:

- Add a conditional column with a short name for each bachelor course (GI – Information Management; STI – Information Technologies Systems)

6.3.3. Fact_Investigation

To structure this input file the following steps were made in Power Query editor:

- Fill with “0” the SDGs columns that were blank;
- Unpivot table function was applied in all columns except the SDGs related ones;
- The new Attribute column was renamed to “SDG”.

Unidade Organica	Labs	SDG	Value
NOVA IMS	NOVA Marketing Analytics Lab	SDG 1	0
NOVA IMS	NOVA Marketing Analytics Lab	SDG 2	1
NOVA IMS	NOVA Marketing Analytics Lab	SDG 3	1
NOVA IMS	NOVA Marketing Analytics Lab	SDG 4	0
NOVA IMS	NOVA Marketing Analytics Lab	SDG 5	0
NOVA IMS	NOVA Marketing Analytics Lab	SDG 6	0
NOVA IMS	NOVA Marketing Analytics Lab	SDG 7	0
NOVA IMS	NOVA Marketing Analytics Lab	SDG 8	1
NOVA IMS	NOVA Marketing Analytics Lab	SDG 9	0
NOVA IMS	NOVA Marketing Analytics Lab	SDG 10	0
NOVA IMS	NOVA Marketing Analytics Lab	SDG 11	0

Figure 31- Fact_Investigation final structure

6.4. DATA VISUALIZATION

The core step of this project is the creation of visualizations to fulfill the requirements established and to show, in different levels, how is the institution contributing to the SDGs achievement.

The information will be divided in 9 report pages presenting different levels and perspectives through the data:

- Glossary – the cover of the project, with the Goal and the metrics described;
- Summary – a brief view through all indicators per SDG;
- Group – analysis of the contribution per SDG Group;
- Education – detailed analysis through the Courses and Course Units and their contribution;
- Projects – detailed analysis through the Projects and their contribution by year;
- Publications – detailed analysis through the Master and PhD publications and their contribution by year;
- Thesis – detailed analysis through the Master and PhD thesis and their contribution by year;
- Investigation – detailed analysis through the university Labs contribution;
- Highlights – some highlights and details through all the indicators in analysis.

To perform this analysis, a set of measures was developed in Power BI desktop using DAX (Data Analysis Expressions) language. The created measures (Appendix 1) will allow the end user to have a vision of which SDGs the university contributes more or less, at a numeric and percentual level.

Some filters were also created, allowing the user to filter by SDG (through the official UN image), group and year.

The Summary page of the Dashboard shows all the contributions per indicator, per SDG, and will allow the final user to have an overall view through the institution status regarding the contributions (Figure 21).

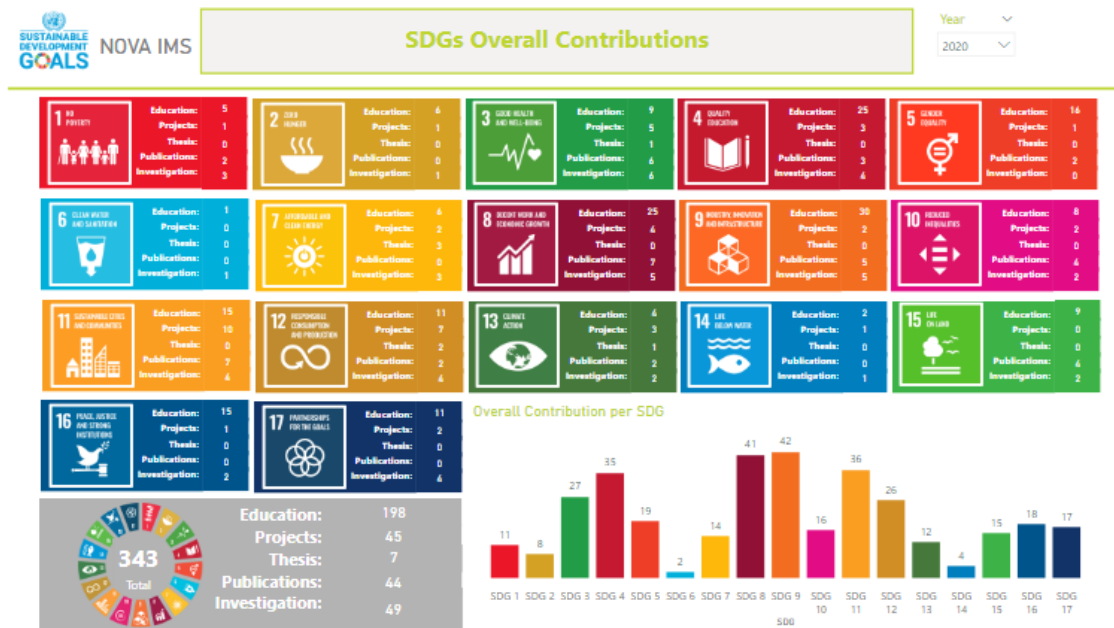


Figure 32- Dashboard: Summary

In the image analysis, is visible that the SDG with more contributions in 2020, is the SDG 9 – Industry, Innovation and Infrastructures, with 42 contributions where the biggest ones are due to Education, Publications and Investigation.

On the other side, SDG 6 (Clean water and Sanitation) and SDG 14 (Life below water) are the ones with the fewest contributions and the university should consider these low values and enhance them in the future.

Figure 33 represents the Education contributions considering the Course Units present in each course, year and semester. The KPI's on top of the page present the Total Contribution considering all Curricular Units and the percentage of contribution, considering the curricular units with no related SDGs. The bar chart shows the impact of each SDG in the different bachelor's at Nova IMS and the table below has all the information detailed.

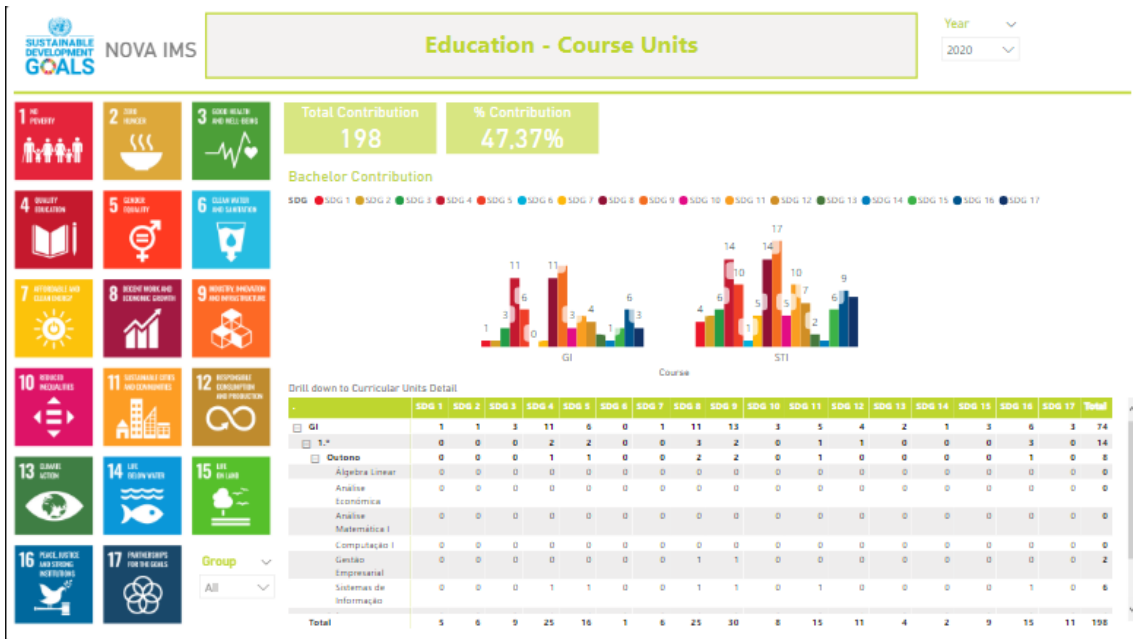


Figure 33- Dashboard: Education

Figure 34 allows the user to understand what the projects contributions throughout the years and the percentage per SDG are. The table shows the detailed information of the projects, allowing the user to drill-down through year and supervisor.

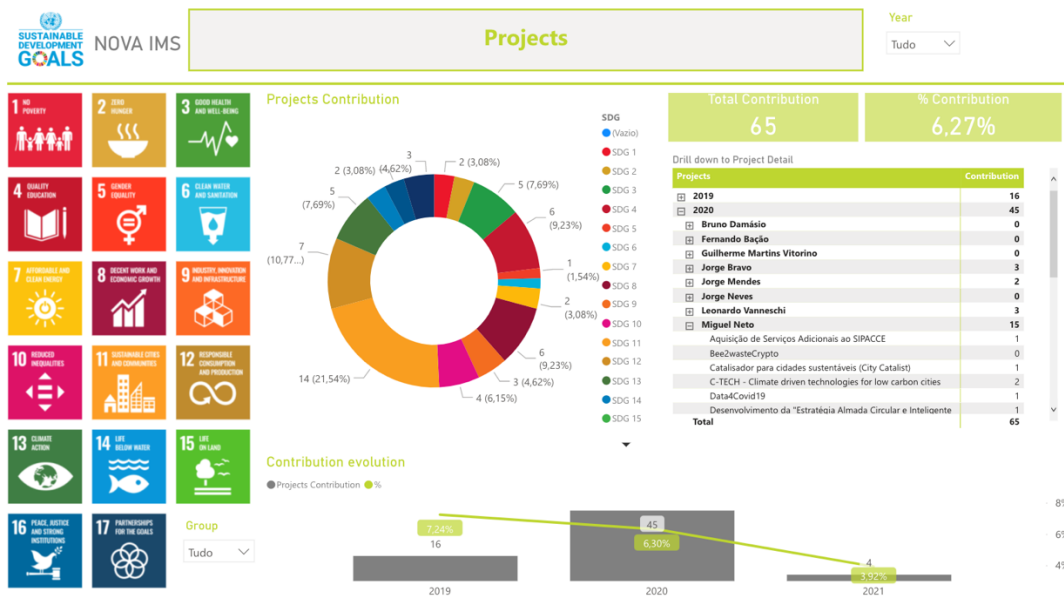


Figure 34- Dashboard: Projects

Power BI also allows user to filter data without using filter panes and because of this feature, when selecting the Project names, the SDGs in the donut chart highlight according to the contribution they made like showed in the Figure 35 below.



Figure 35- Dashboard: Projects filtered

In the Publications sheet (Figure 36), it is visible the distribution of the contribution per SDG and type of publication. Below there is a table with the detail of all publications with the following drill-down: Year → Type of Publication → Supervisor/Professor → Publication title.

As showed below, the type of publication that contributes more to the SDGs are the articles, having 100 contributions, 66 of them in 2021.

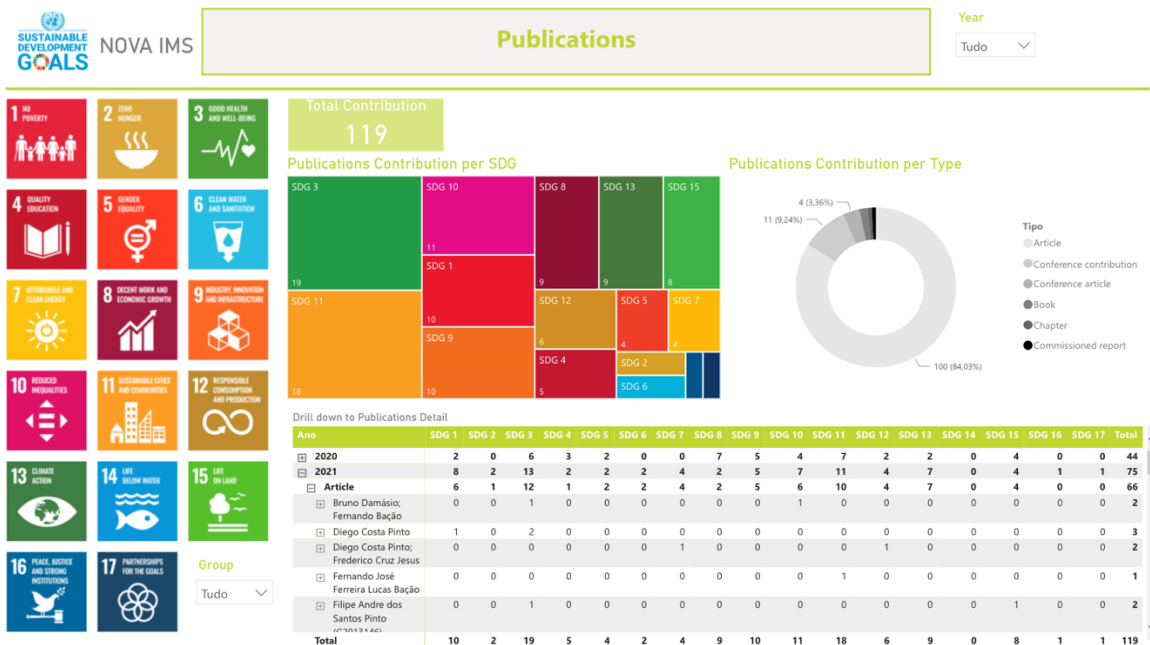


Figure 36- Dashboard: Publications

Figure 37 represents the highlights of the contributions, the right-down donut chart has the total contributions by group and allows to drill-down to the respective SDGs.

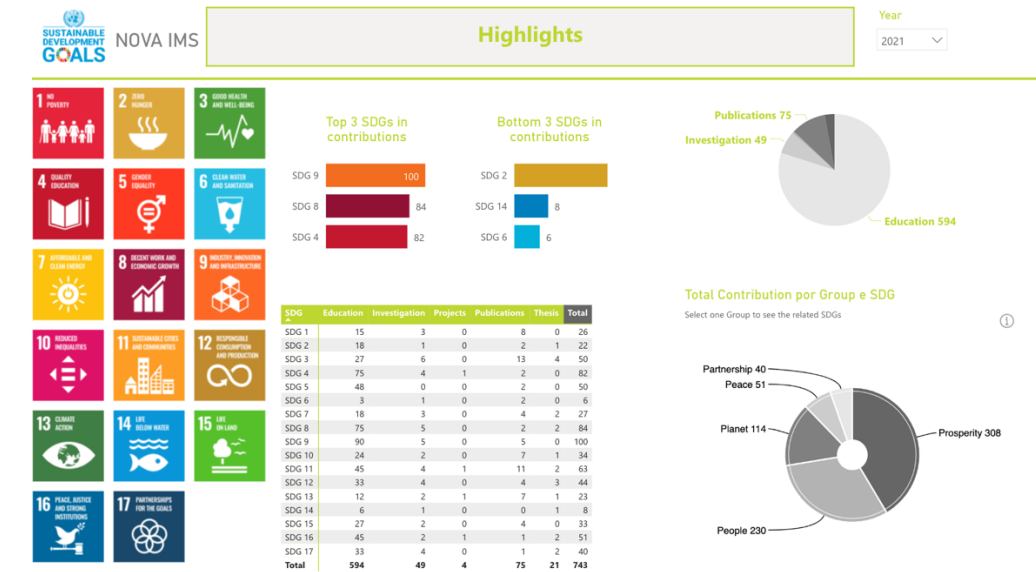


Figure 37- Dashboard: Publications

If we select the Prosperity group (Figure 38), the page is filtered, only showing the 5 SDGs and it is visible that the SDG 9 is the one with more contributions (100).



Figure 38- Dashboard: Highlights

7. RESULTS

The insights obtained by the data exploration in Power BI are represented by charts, schemas, tables and values.

To improve Education, Projects, Thesis, Publications and Investigation in the institution, we can analyze the Nova IMS contribution to the SDGs Dashboard.

Overall Contribution per SDG

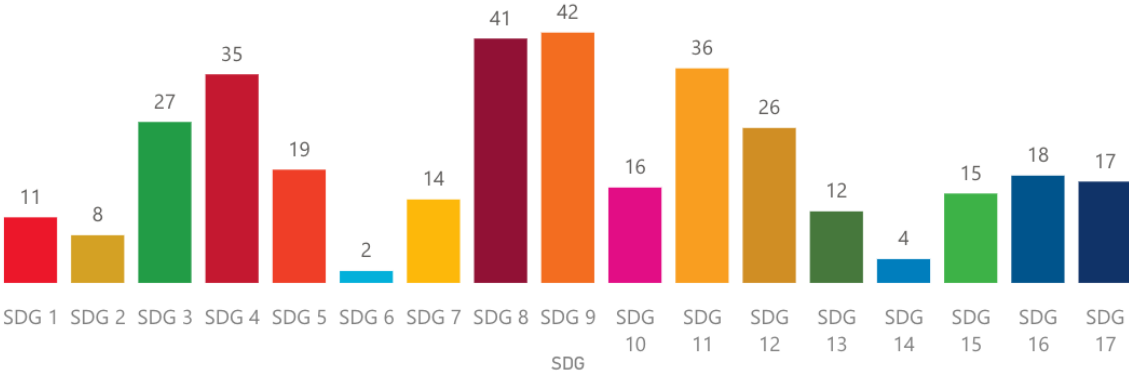


Figure 39- Dashboard: Summary – Overall Contribution per SDG

1. Analyze what are the SDGs with higher contributions and find the ones to enhance;
2. Identify which areas are more focused in contributing, between Education, Projects, Thesis, Publications and Investigation;
3. Identify and analyze the evolution of Projects, Thesis and Publications by year.

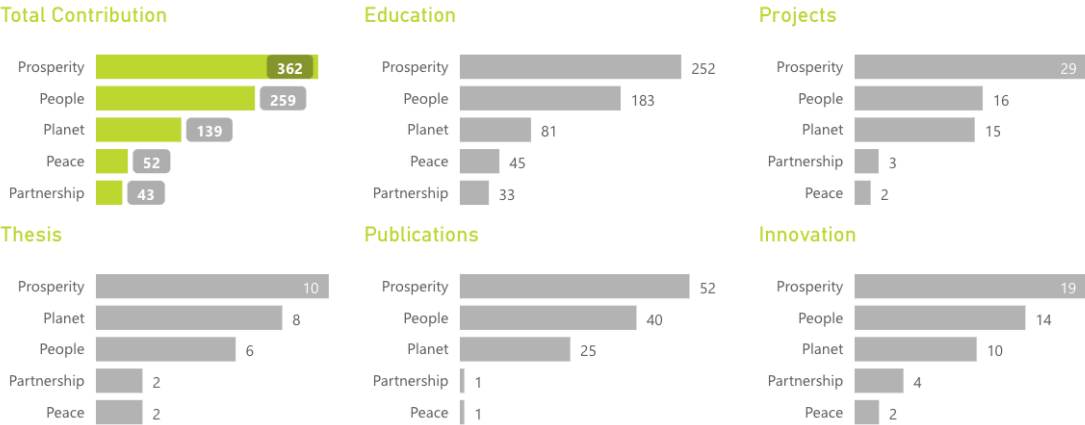


Figure 40- Dashboard: Group – Contributions per Group

The groups with less contributions are also the groups with less related SDGs. However, this can be increased by promoting peace, justice and by creating partnerships for the goals in the institution.

Drill down to Curricular Units Detail

	SDG 1	SDG 2	SDG 3	SDG 4	SDG 5	SDG 6	SDG 7	SDG 8	SDG 9	SDG 10	SDG 11	SDG 12	SDG 13	SDG 14	SDG 15	SDG 16	SDG 17	Total
GI	1	1	3	11	6	0	1	11	13	3	5	4	2	1	3	6	3	74
1.ª	0	0	0	2	2	0	0	3	2	0	1	1	0	0	0	3	0	14
Outono	0	0	0	1	1	0	0	2	2	0	1	0	0	0	0	1	0	8
Algebra Linear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Análise Económica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Análise Matemática I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Computação I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gestão Empresarial	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	2
Sistemas de Informação	0	0	0	1	1	0	0	1	1	0	1	0	0	0	0	1	0	6
Total	5	6	9	25	16	1	6	25	30	8	15	11	4	2	9	15	11	198

Figure 41- Dashboard: Education – Curricular Units detail

There are several drill-down tables in the Dashboard, that will allow the end user to know the details about the data in analysis. Figure 41 shows the contribution per SDG taking into account the Course, the Year of the course, the semester and the name of the curricular Unit.

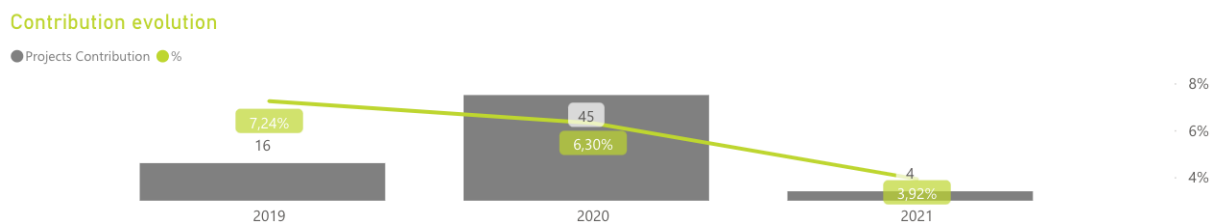


Figure 42- Dashboard: Projects – Contribution Evolution

The projects can be analyzed by year, and because of that we can have a clear view of the increase contribution from 2019 to 2020, the graph also shows the percentage of SDGs that are being fulfilled by the projects contribution.

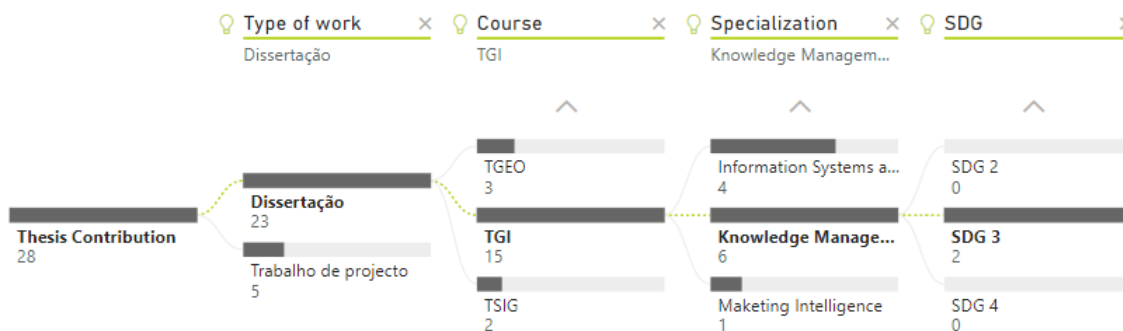


Figure 43- Dashboard: Thesis – Decomposition tree

In the thesis analysis, there is a decomposition tree that allows the end user to decompose the Thesis contribution by the type of work, the course, the Specialization and the related SDGs. This tree is an AI tool allowing to analyze several dimensions and even ask the visual to drill-down taking into account several criteria.

Publications Contribution per SDG

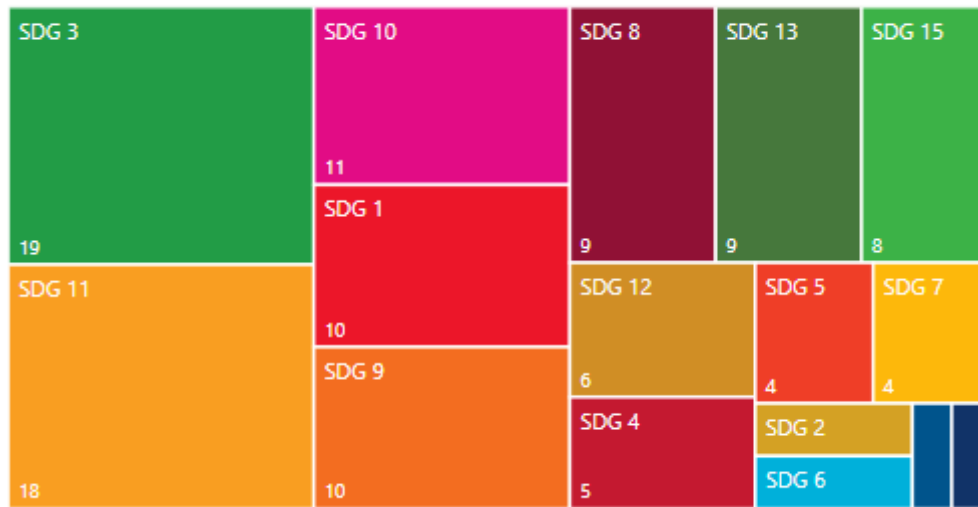


Figure 44- Dashboard: Publications – Treemap

In the Publications analysis, is visible through the treemap, the SDGs that have more weight in the total contributions.

Investigation Contribution per SDG

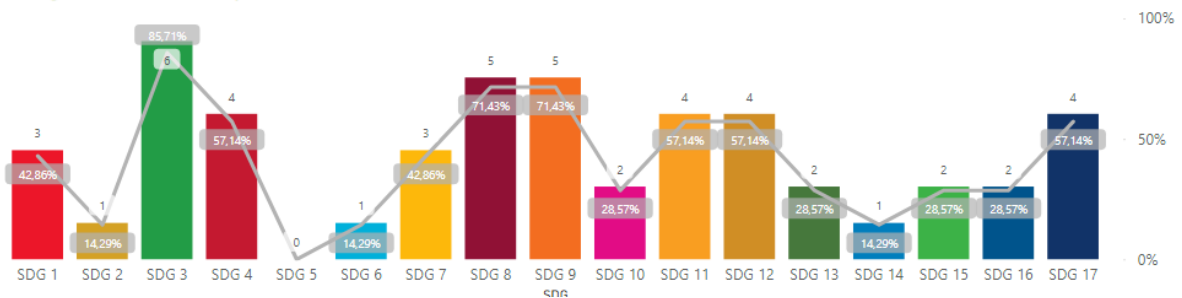


Figure 45- Dashboard: Investigation – Contribution per SDG

Figure 45 shows the contribution of the university labs per SDG and also the respective percentage of each SDG contribution.

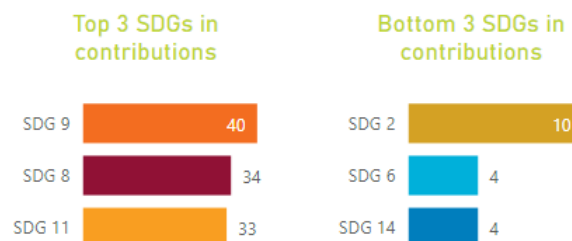


Figure 46- Dashboard: Highlights – Top and Bottom 3

One important highlight is to know overall, what are the SDGs with more and with less contributions, to understand by the ones with more, what should be done to potentiate the ones with less.

8. LIMITATIONS AND RECOMMENDATIONS

The biggest limitation in this work, was the missing data.

The data regarding Education is not all collected, so the input file and the Dashboard will suffer some values transformations. There are some responsible professors that did not answer the questionnaire used to collect all data.

The data collected in terms of Projects, Thesis and Publications have lack of information. In the case of Projects for example, we have data from 2019, 2020, 2021. The lack of data for other years will take into some misunderstandings when it comes to data interpretation. When data is missing, the SDGs are ranked but it may not correspond to the true.

Investigation cannot be analyzed by year because the research projects of the institution have been a constant throughout the years.

9. FEEDBACK

The main objective in the elaboration of the project is the effective implementation in the institution and efficient use by the same.

As such, before the official delivery, feedback on the developed Power BI application was requested from the Dean of Nova IMS, Pedro Saraiva, who reinforced the importance of this project saying it is a very interesting one and will greatly help the university in monitoring the SDGs in different areas now and in the future.

10. CONCLUSIONS

The main goal of this work project was to implement a Business Intelligence solution that could show the Nova IMS contributions to the SDGs as explained in the sub-chapters Background and Problem Identification and Study Objectives.

Taking into account the SDGs matrix defined in the 2030 Agenda, this project was build to allow the Nova IMS to track and communicate their contribution to the SDGs.

Firstly, the data regarding the Projects, Publications, Thesis and Investigation was provided by the university and the data for Education was collected with the responsible professors through a survey.

After all data collected, some transformations were done in excel and the files were imported to Power BI and some structure transformations were also made. The data model was developed to fulfill the project needs.

Building the Dashboard, several metrics were created to analyze the data in the different segments and some intuitive filters were created to allow the end user to filter it in a way that suits best the analysis. The visuals selected to build the dashboard were chosen to provide an accessible way to see and understand the data and the evolution of some indicators.

The missing data in some perspectives of the analysis is a limitation to the results, however, the final result still allows to end user to see where the contributions are being more allocated and to what SDGs.

In the future, is possible to add more data to the sources and refresh the Dashboard to continue the exploration and analysis even for other NOVA Organic Units.

Developing this project, allowed a better understanding of the Power BI tool and the final Dashboard represents a centralized, simple and dynamic contribution to the SDGs, that can be taking to account in the development of other projects to contribute for the SDGs.

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12. APPENDIX

12.1. METRICS TABLE

Education Contribution	Count of SDG column in Education table
% Education Contribution	Education Contribution / Count of all Education rows
Investigation Contribution	Sum of Value column in Investigation table
% Investigation Contribution	Investigation Contribution / Count of all Investigation rows
Projects Contribution (2011, 2015, 2017, 2018, 2019, 2020, 2021)	Sum of Value column in Projects table
% Projects Contribution	Projects Contribution / Count of all Projects rows
Publications Contribution (2020, 2021)	Count of SDG column in Publications table
Thesis Contribution (2020, 2021)	Count of SDG column in Thesis table

Appendix 1- Metrics table

12.2. DASHBOARD: GLOSSARY



Glossary

"HEIs are prerogative entities in knowledge production and communication from education, and in promoting the concept of sustainability through investigation" (Junior et al, 2019)

Goal:

Allow Nova IMS (as a renowned university) to know the positioning regarding the SDGs.

This approach classifies and map the **Education** and **Investigation** activities as well as **Projects**, **Publications** and **Thesis** that contribute for the SDGs achievement while contributing for the institution to monitor and communicate the sustainable practices and to understand the commitment with the 2030 Agenda.

Metrics:

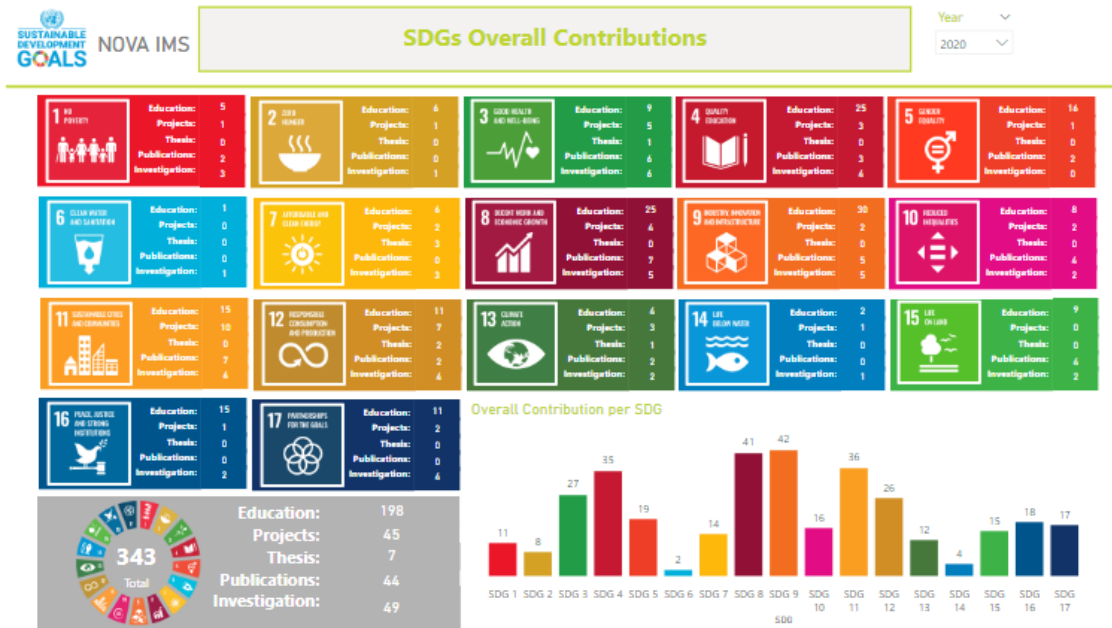
- Education Contribution
- % Education Contribution
- Investigation Contribution
- % Investigation Contribution
- Projects Contribution (2019, 2020, 2021)
- % Projects Contribution
- Publications Contribution (2020, 2021)
- Thesis Contribution (2020, 2021)

Notes:

- Investigation cannot be analyzed by year, because they have been a constant for several years.

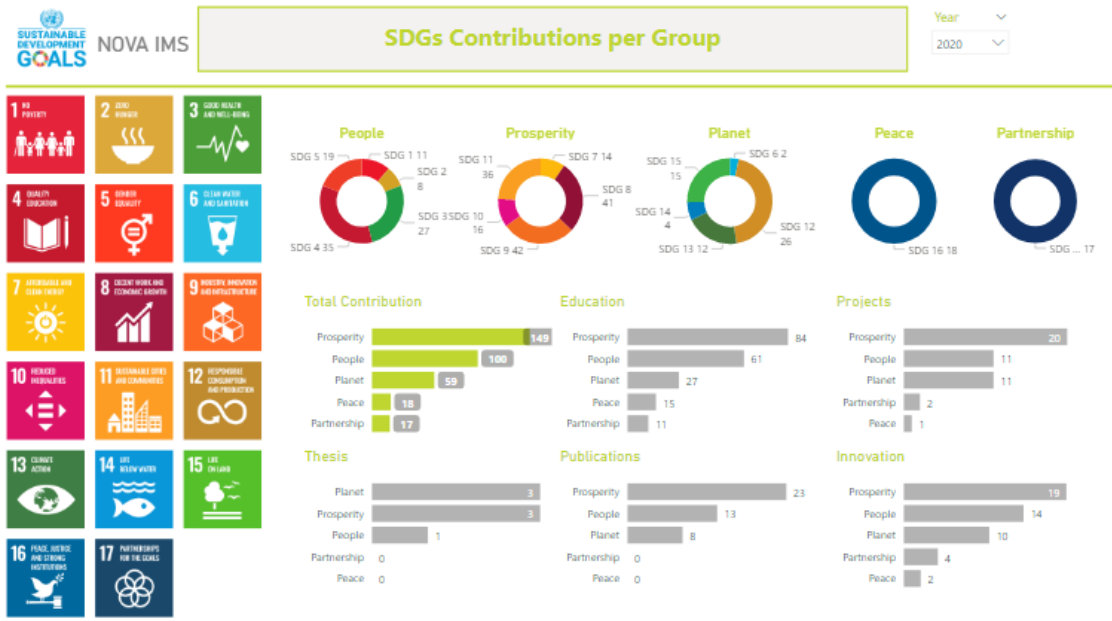
Appendix 2- Dashboard: Glossary

12.3. DASHBOARD: SUMMARY



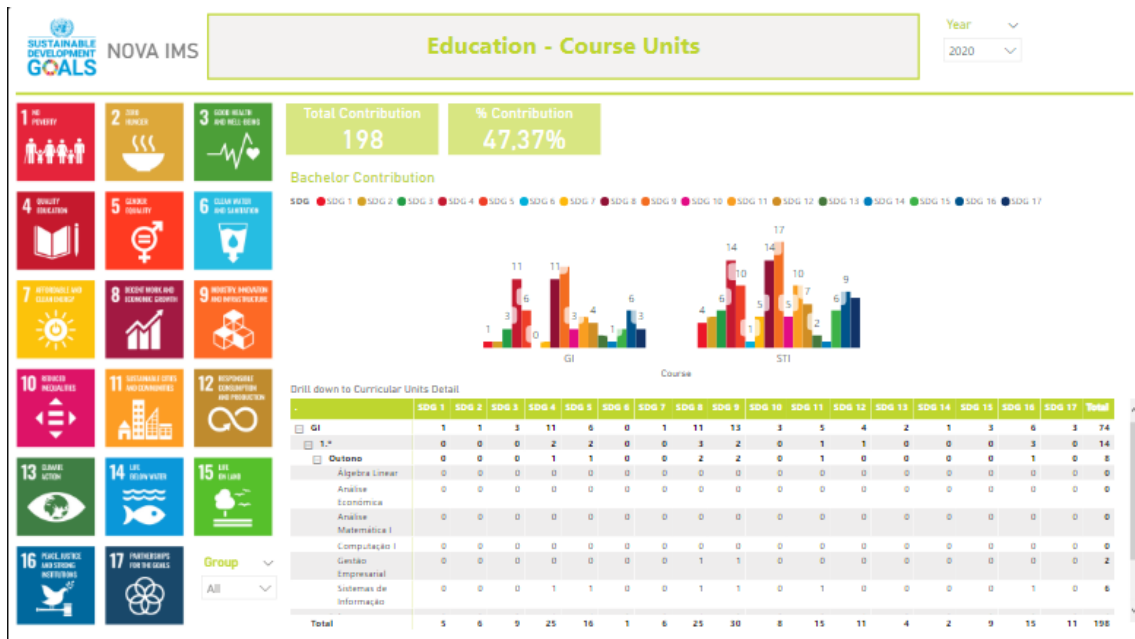
Appendix 3- Dashboard: Summary

12.4. DASHBOARD: GROUP



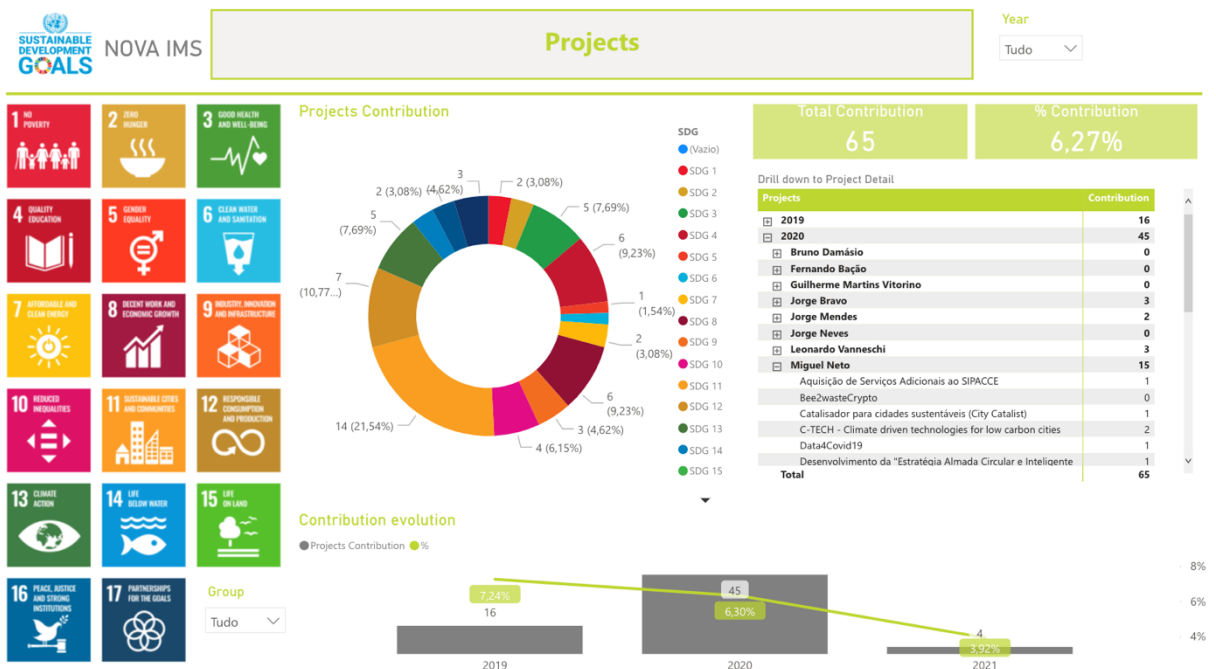
Appendix 4- Dashboard: Group

12.5. DASHBOARD: EDUCATION



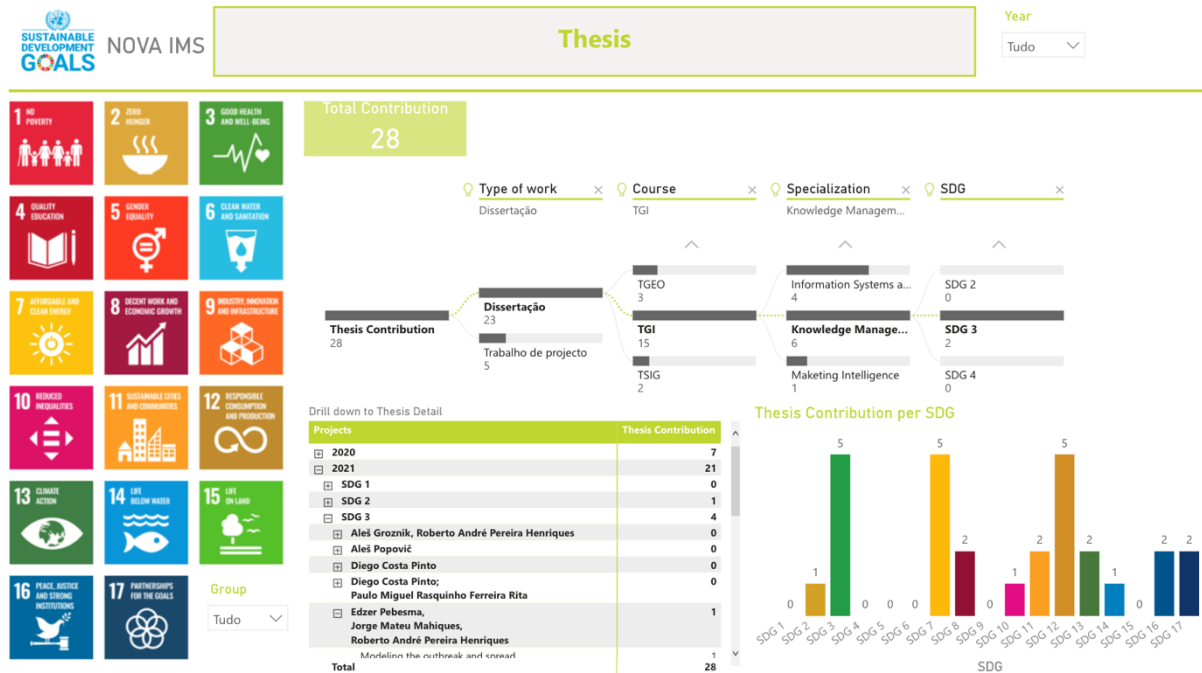
Appendix 5- Dashboard: Education

12.6. DASHBOARD: PROJECTS



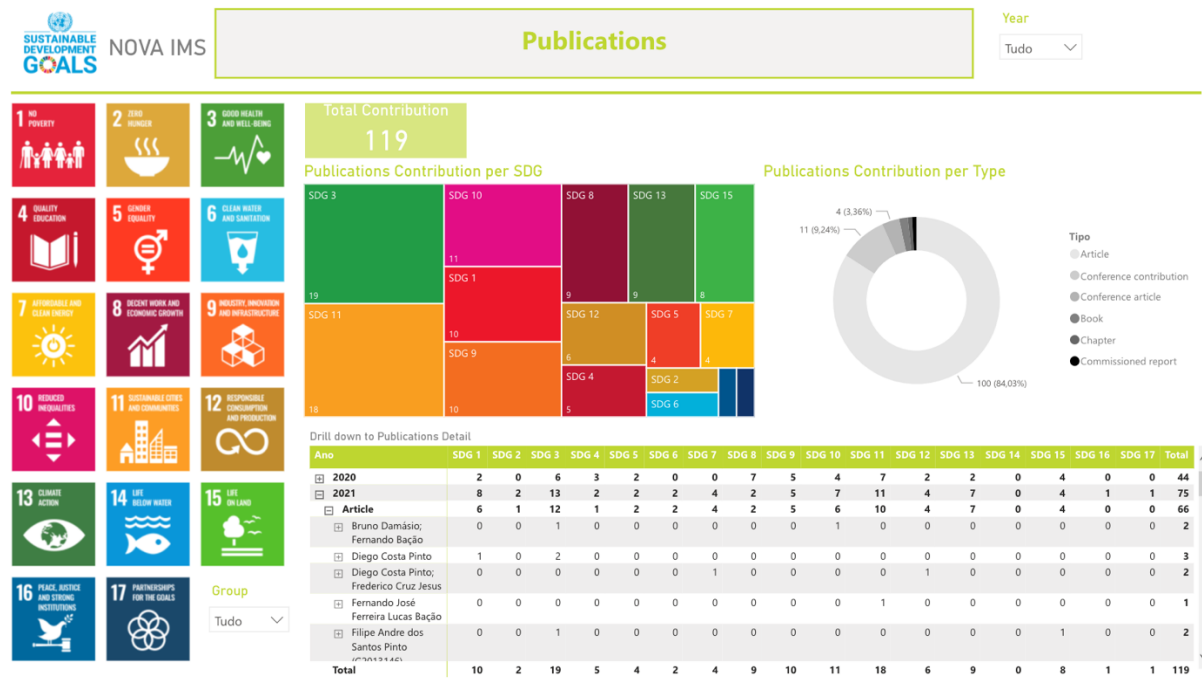
Appendix 6- Dashboard: Projects

12.7. DASHBOARD: THESIS



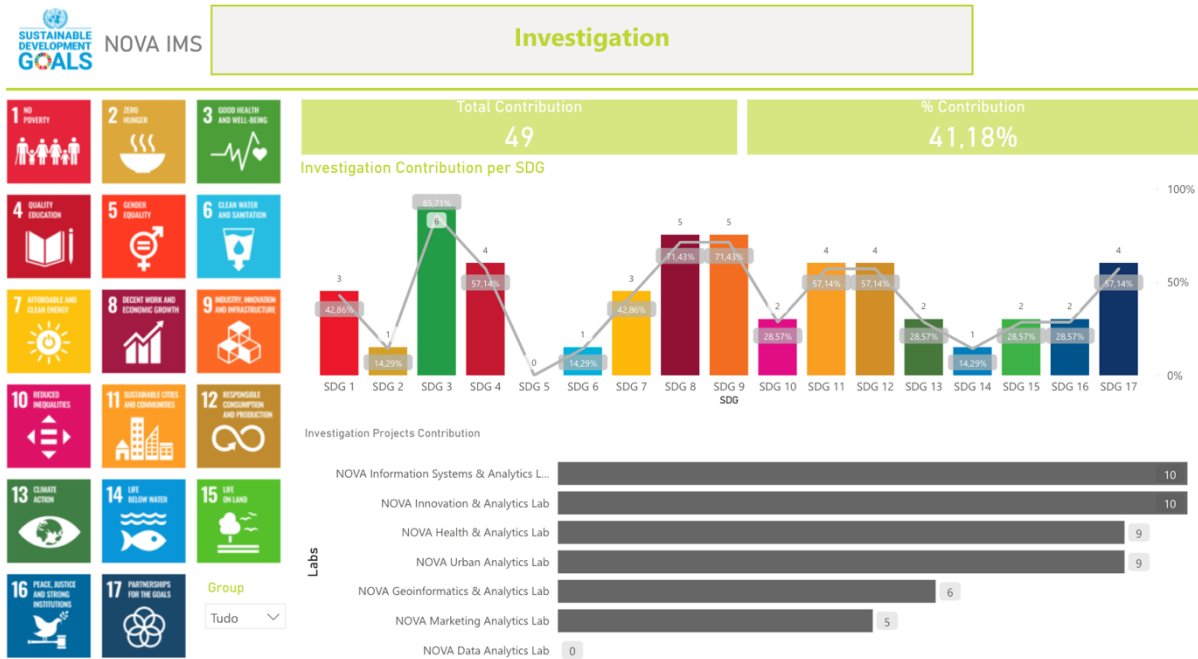
Appendix 7- Dashboard: Thesis

12.8. DASHBOARD: PUBLICATIONS



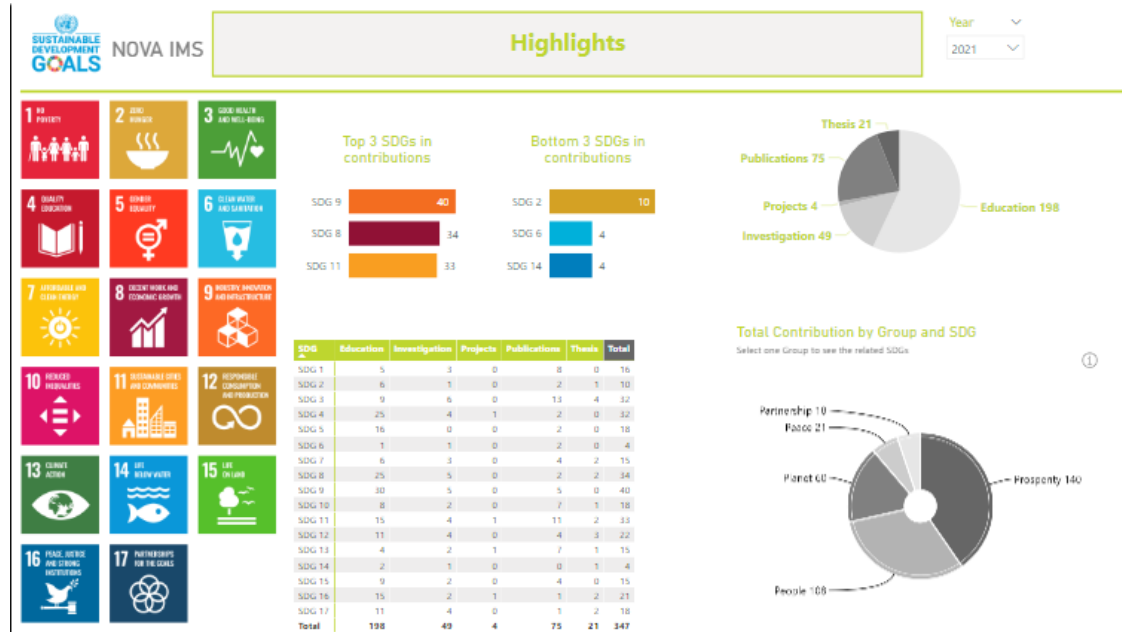
Appendix 8- Dashboard: Publications

12.9. DASHBOARD: INVESTIGATION



Appendix 9- Dashboard: Investigation

12.10. DASHBOARD: HIGHLIGHTS



Appendix 10- Dashboard: Highlights

