Research Positioning &
Trend Identification
– a data-analytics toolbox
Research Positioning & Trend Identification – a data-analytics toolbox

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AIDA was an initiative of TU Delft scientific staff in cooperation with TU Delft Library and Leiden University’s Centre for Science and Technology Studies (CWTS). The aim of the AIDA project was to provide TU Delft researchers and faculties with easy-to-use tools for research positioning and trend identification.

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An electronic version of this booklet is available at http://aida.tudelft.nl/toolbox/aida-booklet.

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How to use this booklet

This booklet introduces a toolbox that will help a wide range of end-users – such as PhD candidates, researchers, group leaders, and university policymakers – to position their research and identify important patterns and trends within their domains of interest. The information provided and the case studies presented were developed based on the questions received from end-users at TU Delft. In compiling this information, extensive use was made of the experience of Leiden University's Centre for Science and Technology Studies (CWTS) and the Research Support of TU Delft library. The presentation style is meant to be visual and easy to use, and to provide practical benefits.

In this booklet, we first introduce the researcher's toolbox, which consists of data collection, analysis, and communication tools. We then provide a list of frequent questions that we have received from our end-users and for each question we indicate the pages in which relevant case studies can be found. Each case study shows some of the methods that can be used to position research and identify trends. We provide a sample illustration and its description for each case study. We explain WHAT the case study is about, WHY it is important, WHO can benefit from it, and HOW you can replicate it or make similar ones based on the data at hand.

For the sake of brevity and simplicity, the HOW section of each case study is abstract and only sketches the approach that you need to follow to replicate the work. A more detailed description of the HOW for each case study is provided online at aida.tudelft.nl. The online material of each case study provides more information including the original data (whenever possible) and the illustrations in digital format.

We encourage you to replicate some of the presented case studies such that you can get similar results as illustrated in this booklet. This will allow you to familiarize yourself with the technicalities of each method.

Last but not least, the information provided in this booklet is meant to be used as a source of inspiration and only as a complementary solution for research positioning and trend identification.
The researcher’s toolbox

The researcher’s toolbox will help you position your research and identify the patterns/trends within your research area. The toolbox should be used in three steps. Step 1 is the data collection step, which will enable you to collect large amounts of data from the relevant databases. The second step is the analysis step, which will enable you to objectively analyze the data using easy-to-use bibliometric analysis tools. Finally, the communication step will help you communicate your findings to the outside world via standard visualization and reporting methods.

It is important to consider each round of using these three steps as only one iteration of the whole process. Depending on the outputs of the analysis and the feedback received after communication, you should iterate through the same steps to make the required improvements.
Step 1: Data collection

About 200 academic databases and search systems are accessible within the network of TU Delft. Although only some academic databases allow the downloading of large batches of data, the most famous ones – including Scopus and Web of Science – do allow it. Below are some of the popular platforms that can be used to collect the research data that you might need.

Scopus provides a subscription-based search tool for research output in the fields of science, technology, medicine, social sciences, and arts and humanities. Scopus features different tools to track, analyze, and visualize research.

Web of Science is an online subscription-based scientific citation indexing service maintained by Clarivate Analytics. It gives access to multiple databases that reference cross-disciplinary research.

Many important journals are indexed by both Scopus and Web of Science. Still, depending on your discipline, you may find one more useful.

IEEEExplore provides access to Institute of Electrical and Electronics Engineers (IEEE) journals, transactions, letters, magazines, and conference proceedings.

ProQuest provides documents from various sources such as newspapers, dissertations and theses, scholarly journals, and television and radio broadcasts.

Mendeley is a reference manager that can help you to manage your research. The collection of publications available in Mendeley provides a dataset that is useful for analysis purposes.
Step 2: Analysis

The analysis of bibliometric data is now easier than ever before thanks to the availability of online analysis tools and standalone software tools. Such tools can answer questions ranging from “Who is the most frequent author in a set of articles?” and “What are the most frequently used keywords in a set of articles?” to more complex questions such as “What is the state of the art in a research domain?”. Some practical analysis tools are introduced below.

**online tools**

The Scopus platform provides an online analysis tool. This tool enables the exploration of data regarding publication year, source of publication, authorship and various other attributes. The interface also provides visualization in the form of distribution graphs, and bar and pie charts.

The Web of Science platform provides an online analysis tool similar to Scopus. This tool provides aggregated statistics on authorship, publication source and year, as well as the funding source and many other attributes of publications.

**standalone tools**

VOSviewer is a software tool for constructing and visualizing bibliometric networks. This tool also offers a text mining functionality that can be used to construct and visualize co-occurrence networks.

CitNetExplorer is a software tool for visualizing and analyzing the citation networks of scientific publications. The networks can be explored interactively.

**general purpose tools**

Various general purpose software tools – such as Excel as a spreadsheet program, Python, R, MATLAB, and Java as programming languages, and Gephi as a network analysis and visualization tool – can also be used for to analyze data.
Step 3: Communication

You can use various approaches to communicate the results of your analysis to your audience. Before communication, however, you should be aware of the caveats and limitations of your analysis. Try to transparently share the methodology of data collection and analysis with your audience, and provide a convenient channel through which they can provide feedback. Below are some suggestions regarding communication.

Add your visualizations to your presentation slides. Such visualizations allow you to convey your message more easily.

Use your visualizations and the statistics that you’ve extracted from your analysis in your research articles. This makes your research outcome more understandable and easier to digest. For examples, check the link below. http://aida.tudelft.nl/toolbox/m3-communication#papers

Your internal project reports provide a perfect medium to store the analysis results. Each single analysis can be summarized with a set of visualizations and statistical information to be documented in your reports. Check the link below for some examples. http://aida.tudelft.nl/toolbox/m3-communication#reports

Presenting analysis results online in the form of interactive web-based visualizations is an effective way to communicate the findings to a large audience. AIDA provides a web-based visualization tool: http://aida.tudelft.nl/WIVOS

A great benefit of translating your message into visualizations is that it broadens its general audience. You can use various social channels to spread your ideas and increase your visibility. Visualizations make your message more appealing and memorable.
End-user questions

This booklet is meant to answer some of the most frequent questions that end-users – including PhD candidates, researchers, group leaders, and policymakers – have asked. For each question, the pages that provide some insights are listed.
State of the art overview

This term map shows the state of the art of the cybersecurity field according to the Scopus search for the term cybersecurity. Studies on techniques, applications, and policies are represented by red, blue, and green clusters, respectively.

**WHAT**
Shows the state of the art in a research field

**WHY**
To get an overview of a research field, find how different subfields are interconnected, and find the potential opportunities for bridging the gaps between subfields

**WHO**
PhD candidates, researchers, group leaders, and policymakers

**HOW**
1. Collect your data from an appropriate data source
2. Import the data into VOSviewer
3. Generate the term map based on text data
4. Use the VOSviewer screenshot to export your map
Evolution of research

This term map shows the state of the art in research on passenger comfort. The overlay color of each circle corresponds to the average publication year of all the papers that include the corresponding term. In this map, the terms with cold colors (e.g., blue) represent the research activities with older average publication year and the terms with hot colors (e.g., red) show the terms with more recent average publication year.

WHAT
Illustrates the evolution of a research area over time

WHY
To understand the trend of research from the past to present

WHO
PhD candidates, researchers, group leaders, and policymakers

HOW
1. Collect your data from an appropriate data source
2. Import the data into VOSviewer
3. Generate the term map based on text data
4. Use the overlay visualization feature to color the circles with the average publication year corresponding to the terms
5. Use the VOSviewer screenshot to export your map
Citation impact

This term map shows the state of the art in research on concrete. The overlay color of each circle corresponds to the average citation impact of all the papers that include the corresponding term. In this map, the terms with cold colors (on the right) represent the research activities with lower number of citations compared to the terms with hot colors (on the left).

WHAT
Distinguishes the terms that have made a higher citation impact than the other terms

WHY
To understand the subareas with higher citation impact

WHO
PhD candidates, researchers, group leaders, and policymakers

HOW
1. Collect your data from an appropriate data source
2. Import the data into VOSviewer
3. Generate the term map based on text data
4. Use the overlay visualization feature to color the circles with the citation impact corresponding to the terms
5. Use the VOSviewer screenshot to export your map
Collaboration profile

This co-authorship map shows the names of authors who are publishing papers in a specific domain. The size of the circles corresponds to the number of papers each author in the publication list has published, and the links between the circles show co-authorships of papers.

WHAT
Reveals co-authorship patterns

WHY
To determine the role of researchers within their research team and identify active research teams

WHO
PhD candidates, researchers, group leaders, and policymakers

HOW
1. Collect your data from an appropriate data source
2. Import the data into VOSviewer
3. Generate the co-authorship map based on bibliographic data
4. Use the VOSviewer screenshot to export your map
Research positioning

Indicates what terms the research outcome of a researcher is focused on

To understand the focus area of a researcher and to find the focal area for potential collaboration

PhD candidates, researchers, group leaders, and policymakers

1. Collect your data from an appropriate data source
2. Generate a corpus and a score file such that in the score file you indicate whether or not each of the corpus file documents belongs to the author in question
3. Generate the term map based on text data (i.e., corpus and score files)
4. Use the overlay visualization feature to color the terms such that the color indicates how often the term is mentioned in the author’s publications
5. Use the VOSviewer screenshot to export your map

This term map visualizes the topics that are being covered by the publications of a group of researchers active in the logistic research area. The circles with hot colors (e.g., yellow and red) represent the expertise area of a specific researcher.
Research showcasing

This term map was generated based on articles written by TU Delft researchers that in their title or abstract include words such as brain or neuro. The colors of circles are determined by the modularity algorithm of the software, which gives the terms that frequently co-occur the same color.

This case study was carried out by Michiel E. Munnik, MSc. For more information, visit brain.library.tudelft.nl.

**WHAT**
Visualizes all or a subset of an organization’s research outcome

**WHY**
To give audiences an objective overview of the organization’s research outcome and allow them to search through the research articles using this visualization

**WHO**
Researchers, group leaders, and policymakers

**HOW**
1. Collect the data corresponding to the research outcome you’re interested in from an appropriate data source
2. Import the data into VOSviewer
3. Generate the term map based on text data
4. Use the VOSviewer screenshot to export your map
5. You can use the AIDA web interface to show the results on your website
Conference submission profile

This term map visualizes the terms that appear in the titles and abstracts of articles submitted to a conference. The large circles indicate which terms are mentioned more frequently. The terms that are closer to each other and have the same color (which is automatically determined by the software), are terms that co-occur very frequently.

Data for this case study is provided by Dr. Mladen Lukovic.

WHAT Provides an overview of the articles (or abstracts) submitted to a conference or journal

WHY To enable conference participants to navigate through the terms mentioned in the submitted papers, and to trace the terms back to the submitted articles

WHO Group leaders and policymakers

HOW 1. Collect the data (authors, titles, and abstracts) of articles submitted to the conference
2. Import the data into VOSviewer
3. Generate the term map based on text data
4. Use the VOSviewer save button to export the map file in txt format
5. You can use the AIDA web interface to show the results on your website
Consortium assembly profile

Illustrates the expertise areas of the members of a consortium

To determine the expertise area of consortium members and identify their common interests

Group leaders and policymakers

1. Collect the data of articles published by members of the consortium
2. Generate a corpus and a score file such that in the score file you indicate which author(s) wrote each of the articles
3. Generate the term map based on text data (i.e., corpus and score files)
4. Use the overlay visualization feature to color the terms such that the color indicates how often the term is mentioned in the publications of an arbitrary author
5. Use the VOSviewer screenshot to export your map
Educational program profile

This term map visualizes the topics that are being covered by the publications of teachers involved in the TU Delft interfaculty program MSc Transport, Infrastructure & Logistics. These teachers have diverse backgrounds and work in different faculties. It would be useful to compare this map with the subject map that should be covered by the educational program and by the research projects that the students carry out.

WHAT
Shows the research activity of the teachers involved in an educational program

WHY
To determine the expertise area of teachers involved in an educational program, which enables the improvement of project proposals and the finding of strong and weak points

WHO
Policymakers

HOW
1. Collect the data of articles published by the teachers involved in the education program
2. Generate a corpus and a score file such that in the score file you indicate which author(s) wrote each of the articles
3. Generate the term map based on text data (i.e., corpus and score files)
4. Use the overlay visualization feature to color the terms such that the color indicates how often the term is mentioned in publications of an arbitrary author
5. Use the VOSviewer screenshot to export your map
Organization overview

This term map was generated based on the research articles written by researchers in an organization that is composed of various departments. Three clusters shown in blue, red and green show the terms that frequently co-occur. This map provides an overview of the organization’s research area and positions the work of each department within the organization.

WHAT Illustrates the research areas covered by an organization

WHY To identify the expertise and potential collaborations within an organization

WHO Group leaders and policymakers

HOW
1. Collect the data of articles published by researchers of an institute
2. Import the data into VOSviewer
3. Generate the term map based on text data
4. Use the VOSviewer screenshot to export your map
5. You can use the AIDA web interface to show the results on your website
CASE 11: Citation networks (1)

This citation network illustrates a set of books and papers published between 1991 and 2016. The top circle represents the book Applied Nonlinear Control, written by J.J. Slotine and W. Li in 1991. The other circles represent the "successor publications" of the book that were published in the following years, have cited the book and have received a high number of citations. Note that the vertical axis represents the year of publication.

WHAT  Depicts the citation network of a set of articles

WHY  To identify the literature on a research topic or explore the publication oeuvre of a researcher

WHO  PhD candidates and researchers

HOW  
1. Collect your data from the Web of Science platform
2. Import the data into CitNetExplorer software tool
3. Use the drill down, expand and analysis features to study the network
4. Use the CitNetExplorer screenshot to export your map
In this citation map, each circle corresponds to an important paper represented by the last name of first author and year of publication. The size of circles corresponds to the number of times the paper has been cited. As can be seen, the colors of the map, which are assigned automatically, show clusters of papers which have cited each other frequently.

**WHAT**
Depicts the citation network of a set of articles

**WHY**
To identify the key publications that are cited frequently with other articles, as well as articles that act as a bridge between different topics

**WHO**
PhD candidates, researchers, and group leaders

**HOW**
1. Collect your data from an appropriate data source
2. Import the data into VOSviewer
3. Generate the citation map based on bibliographic data
4. Use the VOSviewer screenshot to export your map
Journal landscape

This journal landscape was generated by considering the bibliographic coupling between journals related to the field of microbiology. In this map, journals that reference multiple common third journals in their bibliographies (list of references) are connected to each other. As can be seen, the colors of the map, which are assigned automatically, show two clusters of journals that have a high bibliographic coupling.

**WHAT**
Shows how frequently research articles from different journals reference common third journals

**WHY**
To gain a better understanding of the similarity of journals

**WHO**
PhD candidates, researchers, group leaders, and policymakers

**HOW**
1. Collect your data from an appropriate data source
2. Import the data into VOSviewer
3. Generate the bibliographic coupling map in journal level based on bibliographic data
4. Use the VOSviewer screenshot to export your map
This author landscape was generated by considering the co-citation of different papers published in the field of microbiology. In this map, the authors who are mentioned in the bibliographies (list of references) of the papers are shown, and every pair of authors who frequently co-occur in the bibliographies of the same papers are connected to each other. The authors connected to each other or positioned in close vicinity of each other do not necessarily work together, but are active in the same type of research.

**WHAT**
Shows how frequently the articles of different researchers are co-cited by the same articles

**WHY**
To gain a better understanding of the author landscape in a field from an intellectual point of view

**WHO**
PhD candidates, researchers, group leaders, and policymakers

**HOW**
1. Collect your data from an appropriate data source
2. Import the data into VOSviewer
3. Generate the co-citation map in author level based on bibliographic data
4. Use the VOSviewer screenshot to export your map
The above graphs were extracted from the online analysis tool of Scopus. The search was performed on the term bioreactor and the publication year was limited to 2015 and 2016. These graphs are easy to make and provide quantitative information about affiliations, authors, and types and subjects of articles.

**CASE 15:**

**WHAT**
Indicates the aggregated information of a set of publications

**WHY**
To visualize the ranking of universities, important subjects and other properties of scientific articles in a quantitative manner

**WHO**
PhD candidates, researchers, group leaders, and policymakers

**HOW**
1. Run your query in the Scopus or Web of Science platform
2. Use the analysis [search] results link
3. Select the appropriate attribute to see the results
4. Export the graphs or raw data for further analysis
This map visualizes the terms that appeared in news articles on the topic power grid. The color indicates the average year of publication of articles that included each term.

WHAT
Provides an overview of the terms occurred in news articles on a certain topic

WHY
To identify the important topics discussed in news articles and identify links between these topics

WHO
PhD candidates, researchers, group leaders, and policymakers

HOW
1. Go to search.proquest.com and run your query
2. Export your results in RIS format
3. Import the data into VOSviewer
4. Generate the term map based on text data
5. Use the overlay visualization feature to color the circles with the average publication year corresponding to the terms
6. Use the VOSviewer screenshot to export your map
Web media content

This map visualizes the terms that appear in the title or description of a collection of videos that are available online. They were retrieved for the search queries TU Delft and Delft University of Technology. The visualization provides an overview of the topics that these videos are about and the sources used.

This case study was carried out by Michiel E. Munnik, MSc.

WHAT
Provides an overview of the videos that are available online on a topic or institute

WHY
To discover what is shared online about an institute or topic. This allows managers to get a better overview of the infrastructures needed to support, promote, and index the online content

WHO
Policymakers

HOW
1. Use Google (or another platform) to find the media you’re interested in
2. Use a web scraping plug in for your browser to manually convert the search results to csv format (e.g., you can use data scraper - easy web scraping)
3. Generate corpus and score files from the csv file
4. Generate the term map based on text data (i.e., corpus and score files)
5. Use the VOSviewer screenshot to export your map
Open-access zone

This term map shows the state of the art in research on microbiology, based on a search in Scopus. The overlay color of each circle corresponds to the fraction of papers that include the corresponding term and are open access.

Data for this case study was provided by Jorden Esser and Dirk Jan Ligtenbelt.

**WHAT**

Provides an overview of a research area and shows the number of papers published in the form of open-access papers (based on green, blue, yellow, white and gold licenses)

**WHY**

To establish how different research communities within a research area are publishing in open-access form

**WHO**

Policymakers

**HOW**

1. Collect your data from an appropriate data source
2. Use the oaDOI API service to extract the open access status of each article (the oaDOI API needs the DOI of articles).
3. Generate corpus and score files such that the corpus file includes the title and abstract of each article, and that the score file includes the open-access status of the corresponding articles
4. Generate the term map based on text data (i.e., corpus and score files)
5. Use the overlay visualization feature to color the open-access status
6. Use the VOSviewer screenshot to export your map
TU Delft research profile

This term map was generated based on research articles written by researchers at TU Delft. The terms were extracted from the title and abstract of articles. The clusters are automatically detected using the built-in modularity detection algorithm of the VOSviewer software.

This visualization was first published in Delta magazine (No. 7, 6 March 2017).

WHAT  Illustrates the research topics covered by TU Delft researchers

WHY  To provide a better overview of the disciplines that TU Delft researchers work on and the relation between these disciplines

WHO  PhD candidates, researchers, group leaders and policymakers

HOW  1. Collect the data of articles published by researchers
     2. Import the data into VOSviewer
     3. Generate the term map based on text data
     4. Use the VOSviewer screenshot to export your map
This collaboration network was generated based on articles written by TU Delft researchers. The institutes with the highest number of collaborations were chosen, and the colors were used to indicate the citation impact of each collaboration link.

This case study was carried out by Tomas van Dijk and was first published in Delta magazine (No. 9, 24 April 2017).

**WHAT**

Shows TU Delft’s top collaborators and the citation impact of each collaboration

**WHY**

To identify TU Delft's collaborators and the disciplines that each collaboration is built upon, and to evaluate these collaborations

**WHO**

PhD candidates, researchers, group leaders, and policymakers

**HOW**

1. Collect your data from an appropriate data source
2. Import the data into VOSviewer
3. Generate the co-authorship map based on bibliographic data in organization level
4. Use the overlay visualization feature to color the terms based on the citation impact
5. Use the VOSviewer screenshot to export your map
CASE 21:
TU Delft collaborators (2)

This collaboration map was generated based on research articles written by researchers at TU Delft from 2012 to 2018. Each red circle indicates an institution that has published articles together with the researchers of TU Delft (the blue circle) in the mentioned time period.

This visualization is made in collaboration with the CWTS researchers.

WHAT
Shows TU Delft’s collaborators on a geographic map

WHY
To identify TU Delft’s collaborators with a focus on the geographic locations

WHO
PhD candidates, researchers, group leaders, and policymakers

HOW
1. Collect your data from an appropriate data source
2. Import the data into VOSviewer and generate the co-authorship map based on bibliographic data in organization level
3. Save the map file, and change the values in x and y columns of the map file to the longitude and latitude of the corresponding institutions
4. Add extra nodes that represent the country borders [see the online material for more information], and open the updated map file in VOSviewer
5. Use the VOSviewer screenshot to export your map
### Useful links

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<th><strong>Online material</strong></th>
<th>Provides the online material of this booklet with data to download, visualizations and description</th>
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<td><a href="http://aida.tudelft.nl/WIVOS">http://aida.tudelft.nl/WIVOS</a></td>
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<tr>
<th><strong>AIDA project</strong></th>
<th>TU Delft project focused on automatic trend identification</th>
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<tr>
<th><strong>TU Delft Research Support</strong></th>
<th>Portal where researchers can find solutions to their research-related support questions</th>
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<td><a href="http://researchsupport.tudelft.nl">http://researchsupport.tudelft.nl</a></td>
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<th><strong>oaDOI</strong></th>
<th>Provides the full text of scholarly articles, as well as an API to extract the open access status of articles based on DOI</th>
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<td><a href="http://oadoi.org">http://oadoi.org</a></td>
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<th><strong>Pure</strong></th>
<th>Portal to access TU Delft research outcome</th>
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<tr>
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<tr>
<th><strong>Scholarly resource APIs</strong></th>
<th>Provides a list of some scholarly resources that make their APIs available for use</th>
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<td><a href="http://libguides.mit.edu/apis">http://libguides.mit.edu/apis</a></td>
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<th><strong>Mendeley</strong></th>
<th>Reference manager and academic social network</th>
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<td><a href="https://www.mendeley.com">https://www.mendeley.com</a></td>
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AIDA highlights

The AIDA project was carried out by TU Delft and Leiden University’s CWTS in 2016-2017. AIDA used state of the art tools for collection, processing, visualization and interpretation of bibliometric data.

AIDA organized interactive workshops in which researchers from different disciplines worked together to overcome the existing limitations in research positioning and trend identification. Together with the researchers, AIDA created a toolbox consisting of easy-to-use and yet effective software tools for analysis of large bodies of literature.

In order to guarantee a long-term impact, AIDA engaged in dialogues and collaboration with TU Delft researchers and support staff. The informed community allowed AIDA to disseminate the project outcomes to the TU Delft life.

AIDA will be followed-up by various activities including, but not limited to, the following.

- The skills and knowledge developed during the AIDA project will be transferred to the Research Support Center of TU Delft Library for supporting researchers and faculties of TU Delft.
- The pilot software tools produced during the project and the experience of interaction with end-users will be transferred to Leiden University’s CWTS, AIDA partner, for further improvement and developments.
- The research positioning workshops will be organized at the level of the Leiden-Delft-Erasmus partnership.

AIDA initiators

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  TU Delft Library
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The information provided in this booklet could not have been gathered without the support and knowledge sharing of many researchers and supporting staff. Our community provided research questions, helped with carrying out the case studies or supported the Researcher’s toolbox by valuable feedback.

Community

[Images of community members]

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