# FWO DMP Template - Flemish Standard Data Management Plan

Project supervisors (from application round 2018 onwards) and fellows (from application round 2020 onwards) will, upon being awarded their project or fellowship, be invited to develop their answers to the data management related questions into a DMP. The FWO expects a **completed DMP no later than 6 months after the official start date** of the project or fellowship. The DMP should not be submitted to FWO but to the research co-ordination office of the host institute; FWO may request the DMP in a random check.

At the end of the project, the **final version of the DMP** has to be added to the final report of the project; this should be submitted to FWO by the supervisor-spokesperson through FWO's e-portal. This DMP may of course have been updated since its first version. The DMP is an element in the final evaluation of the project by the relevant expert panel. Both the DMP submitted within the first 6 months after the start date and the final DMP may use this template.

The DMP template used by the Research Foundation Flanders (FWO) corresponds with the Flemish Standard Data Management Plan. This Flemish Standard DMP was developed by the Flemish Research Data Network (FRDN) Task Force DMP which comprises representatives of all Flemish funders and research institutions. This is a standardized DMP template based on the previous FWO template that contains the core requirements for data management planning. To increase understanding and facilitate completion of the DMP, a standardized **glossary** of definitions and abbreviations is available via the following link.

## 1. General Project Information

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| Name Grant Holder & ORCID | **Pietro Rinaudo - 0000-0001-7676-1306** |
| Contributor name(s) (+ ORCID) & roles | **Ingrid De Wolf - 0000-0003-3822-5953 (PhD promotor)** |
| Project number[1] & title | **1SE2723N – Reliability of thin film IGZO transistors for logic and memory applications** |
| Funder(s) GrantID[2] | |
| Affiliation(s) | ☑ KU Leuven<br>☐ Universiteit Antwerpen<br>☐ Universiteit Gent<br>☐ Universiteit Hasselt<br>☐ Vrije Universiteit Brussel<br>☐ Other:<br>Provide ROR[3] identifier when possible: https://ror.org/05f950310 |
| Please provide a short project description | Long-term reliability of IGZO transistors is one of the most important aspects to be still fully characterized and understood before full deployment of these devices.  The aim of this PhD research is to study the IGZO TFT electrical reliability, targeting both logic and memory applications. To this end, this novel device type will undergo extensive experimental characterization and be modelled with state-of-the-art device simulators. From the combination of these two complementary approaches, fundamental understanding of the physical (and extrinsic) mechanisms behind performance degradation will be obtained. |

## 2. Research Data Summary

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[1] "Project number" refers to the institutional project number. This question is optional since not every institution has an internal project number different from the GrantID. Applicants can only provide one project number.

[2] Funder(s) GrantID refers to the number of the DMP at the funder(s), here one can specify multiple GrantIDs if multiple funding sources were used.

[3] Research Organization Registry Community. https://ror.org/

List and describe all datasets or research materials that you plan to generate/collect or reuse during your research project. For each dataset or data type (observational, experimental etc.), provide a short name & description (sufficient for yourself to know what data it is about), indicate whether the data are newly generated/collected or reused, digital or physical, also indicate the type of the data (the kind of content), its technical format (file extension), and an estimate of the upper limit of the volume of the data[4].

| | | | | *ONLY FOR DIGITAL DATA* | *ONLY FOR DIGITAL DATA* | *ONLY FOR DIGITAL DATA* | *ONLY FOR PHYSICAL DATA* |
|---|---|---|---|---|---|---|---|
| Dataset Name | Description | New or Reused | Digital or Physical | Digital Data Type | Digital Data Format | Digital Data Volume (MB, GB, TB) | Physical Volume |
| Measurements | Experimental data assessing reliability issues and degradation of electronic devices | ☒ Generate new data <br> ☐ Reuse existing data | ☒ Digital <br> ☐ Physical | ☐ Observational <br> ☒ Experimental <br> ☐ Compiled/ aggregated data <br> ☐ Simulation data <br> ☐ Software <br> ☐ Other <br> ☐ NA | ☐ .por <br> ☐ .xml <br> ☐ .tab <br> ☒ .csv <br> ☐ .pdf <br> ☒ .txt <br> ☐ .rtf <br> ☐ .dwg <br> ☐ .tab <br> ☐ .gml <br> ☐ other: <br> ☐ NA | ☐ < 100 MB <br> ☐ < 1 GB <br> ☒ < 100 GB <br> ☐ < 1 TB <br> ☐ < 5 TB <br> ☐ < 10 TB <br> ☐ < 50 TB <br> ☐ > 50 TB <br> ☐ NA | |
| TCAD simulations | Simulation results for material properties extraction | ☒ Generate new data <br> ☐ Reuse existing data | ☒ Digital <br> ☐ Physical | ☐ Observational <br> ☐ Experimental <br> ☐ Compiled/ aggregated data <br> ☒ Simulation data <br> ☐ Software <br> ☐ Other <br> ☐ NA | ☐ .por <br> ☐ .xml <br> ☐ .tab <br> ☒ .csv <br> ☐ .pdf <br> ☒ .txt <br> ☐ .rtf <br> ☐ .dwg <br> ☐ .tab | ☐ < 100 MB <br> ☐ < 1 GB <br> ☒ < 100 GB <br> ☐ < 1 TB <br> ☐ < 5 TB <br> ☐ < 10 TB <br> ☐ < 50 TB <br> ☐ > 50 TB <br> ☐ NA | |

| | | | | ☐ .gml<br>☐ other:<br>☐ NA | | |
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| If you reuse existing data, please specify the source, preferably by using a persistent identifier (e.g. DOI, Handle, URL etc.) per dataset or data type. | Existing local data from previous/ongoing imec research will be reused for performance/reliability comparisons and benchmarking: this will allow to identify crucial processing/ layout/material properties dependences of devices reliability. |
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[4] Add rows for each dataset you want to describe.
[5] These data are generated by combining multiple existing datasets.

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| Are there any ethical issues concerning the creation and/or use of the data (e.g. experiments on humans or animals, dual use)? If so, please describe these issues further and refer to specific datasets or data types when appropriate. | ☐ Yes, human subject data<br>☐ Yes, animal data<br>☐ Yes, dual use<br>☒ No |
| Will you process personal data[6]? If so, briefly describe the kind of personal data you will use. Please refer to specific datasets or data types when appropriate. If available, add the reference to your file in your host institution's privacy register. | ☐ Yes<br>☒ No |
| Does your work have potential for commercial valorization (e.g. tech transfer, for example spin-offs, commercial exploitation, …)? If so, please comment per dataset or data type where appropriate. | ☒ Yes<br>☐ No<br>Simulation and experimental data will help unveiling reliability issues and possible solutions for IGZO transistors, thus possibly allowing their full implementation in modern electronic devices, especially volatile memories and 3D integrated chips (as they already satisfy the performance requirements). |
| Do existing 3rd party agreements restrict exploitation or dissemination of the data you (re)use (e.g. Material/Data transfer agreements, research collaboration agreements)? If so, please explain to what data they relate and what restrictions are in place. | ☒ Yes<br>☐ No<br>Due to possible industrial applications of the devices and materials under study, the dissemination of data may be limited and/or be possible only after permission. |
| Are there any other legal issues, such as intellectual property rights and ownership, to be managed related to the data you (re)use? If so, please explain to what data they relate and which restrictions will be asserted. | ☒ Yes<br>☐ No<br>All the experimental work and simulations are carried out (and their results stored) in imec, which therefore owns them. |

[6] See Glossary Flemish Standard Data Management Plan

| 3.  Documentation and Metadata | |
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| Clearly describe what approach will be followed to capture the accompanying information necessary to keep **data understandable and usable**, for yourself and others, now and in the future (e.g. in terms of documentation levels and types required, procedures used, Electronic Lab Notebooks, README.txt files, Codebook.tsv etc. where this information is recorded). | Raw experimental data feature automatically generated metadata in the corresponding .txt files; processed experimental data transform raw data to more complex (but systematic) human-friendly data structures, featuring documentation.<br>Simulation input files and results are accompanied by readme-like files explaining simulation parameter meaning and physical model used for each specific simulation. |
| Will a metadata standard be used to make it easier to **find and reuse the data**?<br><br>If so, please specify which metadata standard will be used. If not, please specify which metadata will be created to make the data easier to find and reuse.<br><br>*REPOSITORIES COULD ASK TO DELIVER METADATA IN A CERTAIN FORMAT, WITH SPECIFIED ONTOLOGIES AND VOCABULARIES, I.E. STANDARD LISTS WITH UNIQUE IDENTIFIERS.* | ☐ Yes<br>☒ No<br>Custom (but well documented) metadata will be generated (to uniquely identify measurements setup, measurement condition, device properties) and saved together with the raw and analyzed data.<br><br>Experimental metadata will contain crucial information like measurement type, measurement conditions, device under test properties (geometry, material, processing parameters), timestamp for specific identification. Simulation metadata will contain crucial information like simulation parameters, simulated structure geometry, material implementation, physical models adopted. |

| 4.  Data Storage & Back-up during the Research Project |
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| Where will the data be stored? | As the research is carried out in imec, all data will be stored in the imec cloud storage.<br>They will be stored both in imec personal cloud storage (OneDrive, especially raw and processed data), as well as in specific cloud locations related to imec research programs (especially presentations and tutorials). |
| How will the data be backed up?<br><br>*WHAT STORAGE AND BACKUP PROCEDURES WILL BE IN PLACE TO PREVENT DATA LOSS? DESCRIBE THE LOCATIONS, STORAGE MEDIA AND PROCEDURES THAT WILL BE USED FOR STORING AND BACKING UP DIGITAL AND NON-DIGITAL DATA DURING RESEARCH.[7]*<br><br>*REFER TO INSTITUTION-SPECIFIC POLICIES REGARDING BACKUP PROCEDURES WHEN APPROPRIATE.* | Data are constantly backed up in safe, personal cloud storage space to avoid local data loss (e.g. due to hard-drive failure).<br>Both raw experimental data and simulation input/results files are moved to a specific folder in the cloud storage space immediately after their creation/use. |
| Is there currently sufficient storage & backup capacity during the project? If yes, specify concisely. If no or insufficient storage or backup capacities are available, then explain how this will be taken care of. | ☒ Yes<br>☐ No<br>Storage capacity is not a limiting factor, being related to the constantly growing storage capacity of imec. |
| How will you ensure that the data are securely stored and not accessed or modified by unauthorized persons?<br><br>*CLEARLY DESCRIBE THE MEASURES (IN TERMS OF PHYSICAL SECURITY, NETWORK SECURITY, AND SECURITY OF COMPUTER SYSTEMS AND FILES) THAT WILL BE TAKEN TO ENSURE THAT STORED AND TRANSFERRED DATA ARE SAFE.[7]* | Data can be accessed only by me or by researchers/externals that receive specific permissions, as security policies are automatically implemented when a file is uploaded/created in the cloud storage folder (allowing access to the creator only). |

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[7] Source: Ghent University Generic DMP Evaluation Rubric: https://osf.io/2z5g3/

| What are the expected costs for data storage and backup during the research project? How will these costs be covered? | Costs are covered by imec in its wider corporate data management strategy. |
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| 5. Data Preservation after the end of the Research Project | |
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| Which data will be retained for at least five years (or longer, in agreement with other retention policies that are applicable) after the end of the project? In case some data cannot be preserved, clearly state the reasons for this (e.g. legal or contractual restrictions, storage/budget issues, institutional policies...). | All experimental and simulation data will be retained for at least five years to allow benchmarking and comparison between devices/materials/processes from different generations. |
| Where will these data be archived (stored and curated for the long-term)? | Data will be stored in imec (where this work is carried out) cloud datacenter |
| What are the expected costs for data preservation during the expected retention period? How will these costs be covered? | Costs are covered by imec in its wider corporate data management strategy, as "old" can always be used for benchmarking. |

| 6. Data Sharing and Reuse | |
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| Will the data (or part of the data) be made available for reuse after/during the project? Please explain per dataset or data type which data will be made available.<br><br>*NOTE THAT 'AVAILABLE' DOES NOT NECESSARILY MEAN THAT THE DATA SET BECOMES OPENLY AVAILABLE, CONDITIONS FOR ACCESS AND USE MAY APPLY. AVAILABILITY IN THIS QUESTION THUS ENTAILS BOTH OPEN & RESTRICTED ACCESS. FOR MORE INFORMATION: HTTPS://WIKI.SURFNET.NL/DISPLAY/STANDARDS/INFO-EU-REPO/#INFOEUREPO-ACCESSRIGHTS* | ☐ Yes, in an Open Access repository<br>☒ Yes, in a restricted access repository (after approval, institutional access only, …)<br>☐ No (closed access)<br>☐ Other, please specify: |
| If access is restricted, please specify who will be able to access the data and under what conditions. | Data will be accessible to individuals after access to the cloud storage space is granted by the involved project/program managers. |
| Are there any factors that restrict or prevent the sharing of (some of) the data (e.g. as defined in an agreement with a 3rd party, legal restrictions)? Please explain per dataset or data type where appropriate. | ☐ Yes, privacy aspects<br>☒ Yes, intellectual property rights<br>☐ Yes, ethical aspects<br>☐ Yes, aspects of dual use<br>☐ Yes, other<br>☐ No<br><br>Due to potential industrial deployment of the generated data and results, restrictions may apply for data sharing (especially concerning experimental data). Simulations data should not be as impacted. |
| Where will the data be made available?<br>If already known, please provide a repository per dataset or data type. | When made available after permission, data will be available through ad-hoc folders from imec cloud storage infrastructure. |

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| When will the data be made available?<br><br>*THIS COULD BE A SPECIFIC DATE (DD/MM/YYYY) OR AN INDICATION SUCH AS 'UPON PUBLICATION OF RESEARCH RESULTS'.* | Data will be made available to allowed individuals after publications of research results. |
| Which data usage licenses are you going to provide? If none, please explain why.<br><br>*A DATA USAGE LICENSE INDICATES WHETHER THE DATA CAN BE REUSED OR NOT AND UNDER WHAT CONDITIONS. IF NO LICENCE IS GRANTED, THE DATA ARE IN A GREY ZONE AND CANNOT BE LEGALLY REUSED. DO NOTE THAT YOU MAY ONLY RELEASE DATA UNDER A LICENCE CHOSEN BY YOURSELF IF IT DOES NOT ALREADY FALL UNDER ANOTHER LICENCE THAT MIGHT PROHIBIT THAT.*<br><br>*EXAMPLE ANSWER: E.G. "DATA FROM THE PROJECT THAT CAN BE SHARED WILL BE MADE AVAILABLE UNDER A CREATIVE COMMONS ATTRIBUTION LICENSE (CC-BY 4.0), SO THAT USERS HAVE TO GIVE CREDIT TO THE ORIGINAL DATA CREATORS." [8]* | Data may not be reused due to possible IP limitations, except for allowed individuals or companies. |
| Do you intend to add a PID/DOI/accession number to your dataset(s)? If already available, please provide it here.<br><br>*INDICATE WHETHER YOU INTEND TO ADD A PERSISTENT AND UNIQUE IDENTIFIER IN ORDER TO IDENTIFY AND RETRIEVE THE DATA.* | ☐ Yes<br>☒ No<br>If yes: |
| What are the expected costs for data sharing? How will these costs be covered? | As data are stored in cloud type storage and do not exist physical copies, there is no specific extra cost for sharing. |

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[8] Source: Ghent University Generic DMP Evaluation Rubric:  https://osf.io/2z5g3/

| 7. Responsibilities | |
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| Who will manage data documentation and metadata during the research project? | **Pietro Rinaudo** |
| Who will manage data storage and backup during the research project? | **Pietro Rinaudo** |
| Who will manage data preservation and sharing? | **Pietro Rinaudo** |
| Who will update and implement this DMP? | **Pietro Rinaudo, Ingrid De Wolf** |