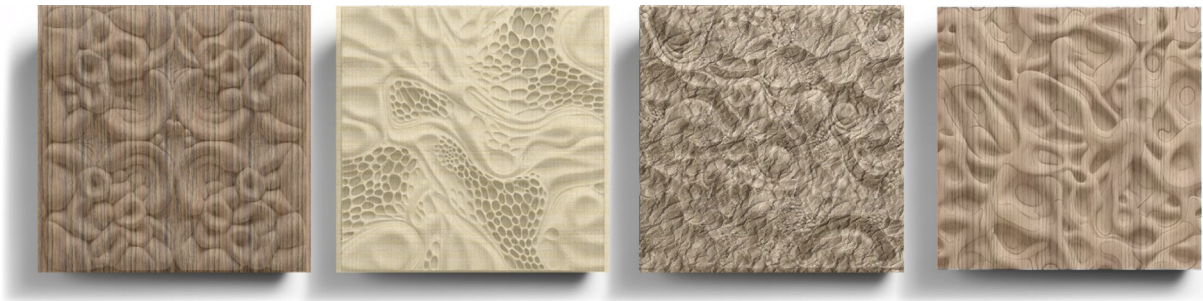


BioReceptive Wood Bio+W



Data Management Plan

Junior Research Project



**Funded by Fonds
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Project Team

Bio+W is led by Principal Investigator Rachel Armstrong, **ZAP Professor of Design-Driven Construction for Regenerative Architecture**, Department of Architecture | Faculty of Architecture, Campus Sint-Lucas, Brussels/Ghent, KU Leuven, Belgium.

Executive Summary

This document, namely the Data Management Plan (DMP), outlines the data management plan and protection approaches employed within the Bio+W project. Specifically, it gives an overview of the data that will be collected during the project through the work packages (WPs) and tasks, and clarifies how these will be collected, stored, and used. This DMP is a dynamic document that will be adapted, refined, and updated throughout the course of the project, as the exact outputs of each WP, and thus the data management requirements, become clearer. Final revisions to the DMP will be incorporated into the final version of the project report and submitted to the FWO at the end of the project.

Bio+W aims to make all data available, aside from any GDPR-sensitive data (which is not expected) and data obtained within the confines of a confidentiality agreement (which is also not anticipated). All Research Data is managed via this detailed Data Management Plan (DMP) and its rolling updates, to ensure that data collected throughout the project, and underpinning the publications, can be accessed (and therefore the results reproduced) and that the data/research outputs are findable, accessible, interoperable, and reusable (FAIR)¹.

¹ Mark D. Wilkinson; Michel Dumontier; IJsbrand Jan Aalbersberg; et al. (15 March 2016). "The FAIR Guiding Principles for scientific data management and stewardship". *Scientific Data*. 3 (1): 160018. doi:10.1038/SDATA.2016.18

Project Summary

"Bioreceptive Wood" (Bio+W) explores enlivening building surfaces through the structured patterning of sustainably sourced, untreated wood. Using the principles of bioreceptive design, which is a building engineering science focussed on the texturing, and patterning of base material surfaces, details on the wood surface form microniches with affordances for biological succession where (mixed) biofilms, and rootless plants (e.g. mosses and lichens) ultimately, give way to higher plants. Bio+W differs from current state-of-the art as current interest in bioreceptive surfaces centres on reducing the environmental impact of concrete. The project aims to develop optimized surface topologies, which enable a range of plants and organisms to be nurtured through the strategic direction of water and air flow.

Bioreceptive performance in Bio+W is evaluated through the fidelity of plant growth patterns based on quantitative measurements and in vitro experiments with respect to change in mass (reflecting water and biomass content), relative humidity, temperature, and percentage cover at scheduled time intervals. The integrity of the panels is also tested at the end of the experiments through static bending and hardness tests.

Bio+W is a foundational system for next-generation sustainable design, which on implementation, enables buildings to benefit from attractive sustainable wooden facades with similar the benefits as low maintenance green walls that increase biodiversity, reduce heat island effects, provide sound insulation, and reduce air pollution.

Document Summary

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** must 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](#).

General Project Information

Name Grant Holder & ORCID	Rachel Armstrong, ORCID: 0000-0002-3516-6815
Contributor name(s) (+ ORCID) & roles	Veerle Van der Sluys, ORCID: 0000-0002-204204068
Project number ² & title	Go48424N– BioReceptive Wood (Bio+W)
Funder(s) GrantID ³	Go48424N
Affiliation(s)	KU Leuven ROR identifier KU Leuven: 05f950310
Please provide a short project description	Bio+W is a foundational system for next-generation sustainable design, which on implementation, enables buildings to benefit from attractive sustainable wooden facades with similar the benefits as low maintenance green walls that increase biodiversity, reduce heat island effects, provide sound insulation, and reduce air pollution.

² “Project number” refers to the institutional project number. This question is optional. Applicants can only provide one project number.

³ 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.

Research Data Summary

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.

All data and research outputs will be evaluated by the PI (Rachel Armstrong) before making datasets open.

For Open Access scientific publications, we will use public shared spaces e.g., arXiv.org. For Green open access Lirias is used. Other project outputs e.g., video, animations, public information are hosted on the project website, the Research Catalogue (www.researchcatalogue.net) and YouTube.

After any IP concerns have been addressed (non-GDPR sensitive and unbound by confidentiality agreements), datasets will be publicly available, and will be given DOI and made publicly available, being deposited in online trusted repositories such as Zenodo, with programming code (e.g. for novel patterns) deposited in GitHub and/or GitLab. Zenodo automatically assigns a persistent identifier (DOI) to all inputs, and the GitHub and GitLab repositories will be linked within the appropriate Zenodo repositories. KUL's institutional repository RDR (<https://rdr.kuleuven.be>) will be used to ensure that all data has a DOI and metadata can be added so it is findable. If open access is not possible, reasons for restricted data sharing for datasets will be given.

Bio+W uses transparent research design, robust statistical analyses, addresses negative results early and shares through a systematic approach to preregistration (protocols, methodology) using The Open Science Framework (OSF) and preprints using arXiv, with open access to software, workflows, tools, etc.

Dataset Name	Description	New or Reused	Digital or Physical	ONLY FOR DIGITAL DATA	ONLY FOR DIGITAL DATA	ONLY FOR DIGITAL DATA	ONLY FOR PHYSICAL DATA
				Digital Data Type	Digital Data Format	Digital Data Volume (MB, GB, TB)	Physical Volume
Software generated patterns	Designed and evolved geometries for	Generate new data	Digital	PSD, PNG, TIFF, MP4, CAD files	PSD, PNG, TIFF, MP4, CAD files	<1GB	N/A

	texturing wooden surfaces						
3D topologies	Designed and evolved geometries for texturing wooden surfaces	Generate new data	Digital	CAD files	CAD files	<1GB	N/A
Surface Cover	Percentage of coverage of wooden tile surface (using grid) and species type	Generate new data	Digital and Physical	Text files, photographs	Word, TIFF, PNG, JPG, txt.	<1GB	10 x 10 or 30 x 30 cm ² tiles
TEXT	Protocols, description of research results, literature studies	Generate new data	Digital	Textual	.txt	1GB	N/A
Microscopy Images	High resolution images of tile surfaces	Generate new data	Digital	Images, films	TIFF, JPG, PNG,	100-200GB	N/A
Microscopy movies	High resolution images of tile surfaces	Generate new data	Digital	Movies	MP4	100-200GB	N/A

Environmental Data	Relative humidity, lux (light intensity), temperature (surface and sub-surface) using on-site	Generate new data	Digital	Numerical	.txt	100-200GB	N/A
Changes in mass of tiles	Gains and losses of mass during the experiment for water retention experiments	Generate new data	Digital	Numerical	.txt	1 GB	N/A
Static bending and hardness tests	Bending strength and modulus of elasticity (flexural modulus)	Generate new data	Digital	Numerical, images	.txt, PNG, TIFF, JPG, MP4	100-200GB	N/A

Documentation and Metadata

In Bio+W, different types of data will be stored in different file formats. All datasets will be exclusively in digital formats and will be created throughout the project as the result of experimental studies. These digital datasets will be stored in a variety of formats and will have volumes ranging from less than 1GB to greater than 50TB.

The data and knowledge produced through this project will provide guidance for the incorporation of surface patterns into different kinds of woods to generate wooden panels with bioreceptive and aesthetic properties. Building on the natural properties of wood, Bio+C intensifies natural processes, which are enhanced by the bioreceptive design making them accessible to further colonisation by organisms, to increase biodiversity, perform ecosystem services and offer an attractive aesthetic appearance for installation within site-specific contexts.

All data generated and/or collected through the project that can be made publicly available (*i.e.*, non-GDPR sensitive data and unbound to confidentiality agreements) **will be deposited online in a trusted repository**. The main repositories that will be used are Zenodo for the general content and GitHub and GitLab for programming code (*e.g.*, written in R). Data entered in GitHub/GitLab will be linked to Zenodo. All open access data in the repositories will be licensed through CC-BY, CC-o, or an equivalent license. Publications generated using project data will be deposited in a trusted repository at the time of publication. All information required for the understanding, reuse, or repurposing of the data will be attached to the data, and all information necessary to repeat, recreate, and validate the results will accompany the publications. In the repository, immediate open access will be provided. When reports or scientific papers are written using processed, pseudonymized, and/or anonymized data, open access will be granted through a trusted repository. Data containing GDPR-sensitive information and data obtained through confidentiality agreements will not be made publicly available, but these datasets will be deposited in a trusted data repository, with a DOI, metadata, and access restrictions in a repository like Zenodo or RDR.

The data will be stored in open non-proprietary formats such as (JPEG/PNG/TIFF, PDF, PSD, MP4, txt, etc.). If proprietary formats are used internally, a usable copy will be available in one of the recommended open formats. All outputs or processed data produced through the project workflow that are neither confidential nor GDPR sensitive will be made publicly available as licensed under CC-BY or an equivalent/comparable license, with metadata licensed under CC-o, as is automatically done when using Zenodo. Data deposited in Zenodo will always be described with metadata and is compliant with DataCite, a leading global non-profit organization that provides persistent identifiers (specifically DOIs) for research data and other research outputs. All relevant materials will be directed to DataCite servers during DOI registration and indexed therein. Zenodo automatically catalogues the metadata, with relevant statistics reported, such that the data and metadata can be seamlessly harvested through the platform.

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).

[RDM guidance on documentation and metadata.](#)

Protocols

All data will be made available collected throughout the project so it can be accessed (and therefore the results reproduced). Data/research outputs are findable, accessible, interoperable, and reusable (FAIR)⁴. Types of data/research outputs include experimental laboratory data (images/microscopy, laboratory reports, text files, calculations, adapted figures), algorithms/AI, digital modelling software, drawings, images (photographs), integration protocols (documents), video, CAD files (3D models), design-led research outputs (video, photographs), and research publications (DTP, text/image). All deliverables will require the generation of novel (i.e., new) data by consortium members through surveys, meta-analyses, and experiments.

Data Capture: information regarding choice of wood, materials (settings, parameters, set-up apparatus, physical conditions e.g. relative humidity) and experimental methods) will be carefully recorded and stored on a secure shared server using open non-proprietary formats such as (JPEG/PNG/TIFF, PDF, JSON, CSV, RDF). If proprietary formats are used internally, a usable copy will be available in one of the recommended open formats.

The research progress and obtained data will be regularly documented, detailing the findings, and noting how the results were generated.

Experimental data will be collected in an electronic notebook (eLABJournal) with folders provided for all subtasks of the project. In each folder, a new file will be made for each experiment, named with the date and subject, and including information on the people involved as well as version tracking. Each experimental file will contain a section on the objectives, protocols, results (a description of results and observations) and conclusions. For each experiment, all raw and analysed data files will be stored in a folder on the shared server, using the same hierarchical folder structure as the eLABJournal. By using the same structure on the server and in the electronic eLABJournal,

⁴ Mark D. Wilkinson; Michel Dumontier; IJsbrand Jan Aalbersberg; et al. (15 March 2016). "The FAIR Guiding Principles for scientific data management and stewardship". *Scientific Data*. 3 (1): 160018. doi:10.1038/SDATA.2016.18

	<p>contextual information on the experimentally obtained data can be easily searched and used by other researchers via the electronic notebook.</p> <p>A physical sample inventory: will be created within the workshop to archive and display wooden panels and prepare them for analysis or exhibition.</p>
<p>Will a metadata standard be used to make it easier to find and reuse the data?</p> <p>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.</p> <p><i>REPOSITORIES COULD ASK TO DELIVER METADATA IN A CERTAIN FORMAT, WITH SPECIFIED ONTOLOGIES AND VOCABULARIES, I.E. STANDARD LISTS WITH UNIQUE IDENTIFIERS.</i></p>	<p><input checked="" type="checkbox"/> No</p> <p>If no, please specify (where appropriate per dataset or data type) which metadata will be created:</p> <p>No uniform metadata standard exists for all different aspects and disciplines of this project. Instead, a uniform system will be created for Bio+W to enhance the use of secondary data using the eLABJournal to establish several key, predetermined topics that are described for each experiment (objective, protocol, results, and conclusion). The eLABJournal therefore, facilitates searching for metadata using a search engine. By mimicking the folder structure of the eLABJournal the server-based folder with the experimental data, linking of the metadata to the actual data will be facilitated.</p>

Data Storage & Back-up during the Research Project

<p>Where will the data be stored?</p> <p><i>Consult the interactive KU Leuven storage guide to find the most suitable storage solution for your data.</i></p>	<p> <input type="checkbox"/> Shared network drive (J-drive) <input type="checkbox"/> Personal network drive (I-drive) <input checked="" type="checkbox"/> OneDrive (KU Leuven) </p> <p>The time-stamped digital data will be stored in a project folder on the shared drive (J:) of KU Leuven. The time-stamped digital metadata will be stored on the server of the eLABJournal, and .pdf exports will be made on a weekly basis to be saved on the shared drive (J:) and OneDrive (KU Leuven). The folder will be open for the members participating in this FWO project and is secured and backed-up by the ICTS service of KU Leuven. Copies can be made and kept on personal devices. An additional back up will be stored on the shared drive (K:) of KU Leuven and will be updated on a yearly basis.</p>
<p>How will the data be backed up?</p> <p><i>WHAT STORAGE AND BACKUP PROCEDURES WILL BE IN PLACE TO PREVENT DATA LOSS?</i></p>	<p><input checked="" type="checkbox"/> Standard back-up provided by KU Leuven ICTS for my storage solution.</p> <p>The digital data will be stored on the university's central servers with automatic daily back-up Procedures.</p>
<p>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.</p>	<p><input checked="" type="checkbox"/> Yes</p> <p>KU Leuven provides sufficient storage and back-up capacity during and after the project. A dedicated folder will be made for the project on which the collaborators will work jointly and store data files.</p>

<p>How will you ensure that the data are securely stored and not accessed or modified by unauthorized persons?</p> <p><i>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.</i></p> <p><u>Guidance on security for research data</u></p>	<p>The network drive for the FWO project folder and the large volume storage folder are secured by the ICTS service of KU Leuven with a mirror copy. Only other lab members will have access to the shared folder. Unauthorized persons do not have access to this system.</p>
<p>What are the expected costs for data storage and backup during the research project? How will these costs be covered?</p>	<p>There are no expected costs for data storage. OneDrive for business is free for staff and students of KU Leuven. However, should data during the retention period be necessary, then the bench fee of the researcher will be used.</p>

Data Preservation after the end of the Research Project

Data and research outputs will be stored within the institutional servers at KUL, and data that is GDPR sensitive or obtained through confidentiality agreements will stay there in a safe, enclosed environment only allowing access to the persons directly involved in that specific part of the deliverable. In the case that a participant gives permission to the researchers to share personal information with other partners or research projects, this will be documented through the signing of an informed consent document, but without this signed consent document, sensitive data will not be made publicly available and will not be shared with other project partners. Data that can be accessed by project participants will be placed on the project SharePoint, with access restricted to only those actively involved in the project, where access will be controlled by the principal investigator (Rachel Armstrong).

The (meta) data will be retained as long as possible provided the repository remains active, this will be far beyond the end of the Bio+W project, ensuring these data remain available to the scientific community for the years to come.

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...).

[Guidance on data preservation](#)

☒ All data will be preserved for 10 years according to KU Leuven RDM policy

<p>Where will these data be archived (stored and curated for the long-term)?</p> <p><i>Dedicated data repositories are often the best place to preserve your data. Data not suitable for preservation in a repository can be stored using a KU Leuven storage solution, consult the interactive KU Leuven storage guide.</i></p>	<p><input checked="" type="checkbox"/> KU Leuven RDR</p> <p><input type="checkbox"/> Large Volume Storage (longterm for large volumes)</p> <p><input type="checkbox"/> Shared network drive (J-drive)</p> <p><input type="checkbox"/> Other (specify):</p> <p>1) The digital data will be stored on the university's central servers (with automatic backup procedures) for at least 10 years, conform the KU Leuven RDM policy.</p> <p>2) The physical data will be stored in a locked workshop with formal storage space in the host lab for up to 10 years after the project.</p> <p>3) The eLABJournal metadata will be stored in the electronic lab notebook.</p>
<p>What are the expected costs for data preservation during the expected retention period? How will these costs be covered?</p>	<p>There are no expected costs for data storage. OneDrive for business is free for staff and students of KU Leuven. However, should a paid service be necessary to store data during the retention period, then the bench fee of the researcher will be used.</p>

Data Sharing and Reuse

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.

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](https://wiki.surfnet.nl/display/STANDARDS/INFO-EU-REPO/#INFOEUREPO-ACCESSRIGHTS)

- ☐ Yes, as open data
- ☒ Yes, as embargoed data (temporary restriction)
- ☐ Yes, as restricted data (upon approval, or institutional access only)
- ☐ No (closed access)
- ☐ Other, please specify:

If access is restricted, please specify who will be able to access the data and under what conditions.

The data will be embargoed for three years while the researcher will be working on the project outputs and then opened (open access) once the publications are made public.

<p>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.</p>	<p><input checked="" type="checkbox"/> Yes, intellectual property rights</p> <p>If yes, please specify: Intellectual property rights will be sought for specific designs and production processes with commercial value to the project. A maximum 6-month period during which IP protection will be assessed/secured is envisaged.</p>
<p>Where will the data be made available? If already known, please provide a repository per dataset or data type.</p>	<p><input checked="" type="checkbox"/> KU Leuven RDR</p> <p>All digital data will be stored and be available for lab members using a shared network drive and large volume storage provided by the KU Leuven. In addition, the relevant data will be made available to external people upon request by mail.</p>
<p>When will the data be made available?</p>	<p><input checked="" type="checkbox"/> Upon publication of research results</p>

<p>Which data usage licenses are you going to provide? If none, please explain why.</p> <p><i>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.</i></p> <p><i>Check the RDR guidance on licences for data and software sources code or consult the License selector tool to help you choose.</i></p>	<p><input checked="" type="checkbox"/> CC-BY 4.0 (data)</p> <p><input checked="" type="checkbox"/> Data Transfer Agreement (restricted data)</p> <p><input type="checkbox"/> MIT licence (code)</p> <p><input type="checkbox"/> GNU GPL-3.0 (code)</p> <p><input type="checkbox"/> Other (specify)</p>
<p>Do you intend to add a PID/DOI/accession number to your dataset(s)? If already available, please provide it here.</p> <p><i>INDICATE WHETHER YOU INTEND TO ADD A PERSISTENT AND UNIQUE IDENTIFIER IN ORDER TO IDENTIFY AND RETRIEVE THE DATA.</i></p>	<p><input checked="" type="checkbox"/> Yes, a PID will be added upon deposit in a data repository</p> <p><input type="checkbox"/> My dataset already has a PID</p> <p><input type="checkbox"/> No</p>
<p>What are the expected costs for data sharing? How will these costs be covered?</p>	<p>The expected data sharing costs are minimal and covered by university services.</p>

Responsibilities	
Who will manage data documentation and metadata during the research project?	The principal investigator (Rachel Armstrong) will be responsible for supervising the data collection, documentation, metadata and managing the data storage facilities. An appointed doctoral researcher (currently under recruitment) will be responsible for all day-to-day data collection and storage in the correct locations.
Who will manage data storage and backup during the research project?	The principal investigator (Rachel Armstrong) will be responsible for how the data is stored on the appropriate accommodation provided by KU Leuven. The ICTS service of KU Leuven is responsible for the back-up of the network drives at KU Leuven. The folders will be managed by the doctoral student on a day-to-day basis but under the supervision of the PI.
Who will manage data preservation and sharing?	While the project is ongoing, the principal investigator (Rachel Armstrong) will supervise the data preservation that is collected by the appointed doctoral researcher. The PI will also take care of the preservation after the completion of the doctoral dissertation. The researcher will manage the sharing of the data.
Who will update and implement this DMP?	The principal investigator (Rachel Armstrong) will update and implement the DMP.

