Re-UNITA WORKSHOPS E-BOOK

Research Challenges for Cultural Heritage, Circular Economy and Renewable Energies in rural and mountain areas

University of Beira Interior, 18th and 19th of April 2024

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement nº 101035810

TECHNICAL SPECIFICATIONS

Title
Re-UNITA WORKSHOPS
Research Challenges for Cultural Heritage, Circular Economy and Renewable Energies in rural and mountain areas
University of Beira Interior, 18th, and 19th April 2024

Supervision
Frederic Marias
Sílvia Socorro
Research HUBs Coordinators and Vice-Coordinators

Team
All contributors

Cover Design
UBIEdições

ISBN
978-989-9239-02-9 (pdf)

DOI
Re-UNITA WORKSHOPS: Research Challenges for Cultural Heritage, Circular Economy and Renewable Energies in rural and mountain areas
https://doi.org/10.25768/9239-02-9

Covilhã, 2024

Editing and Graphic Design
UBI Edições
Tipografia da Universidade da Beira Interior
Rua Marquês d'Ávila e Bolama | 6201-001 Covilhã - Portugal
www.ubi.pt

List of Contents

7 **1. FOREWORD**
Frederic Marias

9 **2. EXECUTIVE SUMMARY**
Sílvia Socorro

3. From the CULTURAL HERITAGE Workshop
PART I. Research Projects in Cultural Heritage

11 **3.1. Research Projects at the ITEM laboratory of the Université de Pau et des Pays de l'Adour in Cultural Heritage of Mountain Areas**
Dénes Harai

19 **3.2. The Linked Open Data Cataloging System ACUSTEME. Semantic Interoperability in the Ethnomusicological, Musicological and Ethnographic Domain**
Giulia Ferdeghini, and Ilario Meandri

37 **3.3. Food Heritage: from Scientific Research to Academic Education. A case study: Universitatea de Vest din Timișoara (Romania)**
Otilia HEDEȘAN and Dana PERCEC

45 **3.4. Research into intellectual and cultural heritage: methodological experiments**
Jacques Ibanez Bueno

PART II. Discussion topics in the Cultural Heritage round-table
Mooderator: Helena Alves
Round-table members: Giovanna Hendel, Giulia Ferdeghini, Otilia Hedeșan, Dana Percec, Renata Ferraz

57 **3.5. Notes from the round-table moderator**
Helena Alves

61 **3.6. Some past Cultural Heritage Hub successful projects and some more to come**
Giovanna Hendel

65 3.7. Encouraging participation through actions that support students' training and academic career
Giulia Ferdeghini

69 3.8. UNITA provides an opportunity for scholars to work together cultural heritage
Otilia Hedeșan and Dana Percec

73 3.9. Re-UNITA Workshops: for an effective communication to and beyond the Cultural Heritage HUB
Renata Ferraz

4. From the CIRCULAR ECONOMY Workshop
PART I. Research Projects in Circular Economy

77 4.1. SCARF Project - Design of Sustainable, CreAtive and Resilient Fibersheds
Ana Margarida Ferreira

PART II. Discussion topics in the Circular Economy round-table
Moderator: Ana Paula Duarte
Round-table members: Sandra Ferreira, António Albuquerque
Tânia Lima, Karine Ricaud, Ion Imbrescu, Nicoleta Sîrghi

81 4.2. Statistical Contributions to Circular Economy: Analysis, Modeling, and Evaluation for Sustainable Practices
Sandra Ferreira

83 4.3. Challenges for the Circular Economy and Environmental Protection in Rural and Mountain Regions
António Albuquerque

85 4.4. Recycling and reuse of industrial waste
Tânia Lima

89 4.5. Comments on the Circular Economy round-table
Karine Ricaud

93 4.6. UNITAed we can!
Ion Imbrescu

97 4.7. The role of universities in education for a sustainable future through the Circular Economy
Nicoleta Sîrghi

5. From the RENEWABLE ENERGIES Workshop
PART I. Research Projects in Renewable Energies

103 5.1. Research Challenges for renewable energies
María Paz Comech

115 5.2. Modeling and measurements of solar radiation at West University of Timisoara
Andreea Sabadus

129 5.3. Comparative Analysis of Thermal Performance in Greenhouses: An Experimental and Numerical Study
Rodrigues Pascoal Castro

PART II. Discussion topics in Renewable Energies round-table
Moderator: Luís Carlos Carvalho Pires
Round-table members: Frédéric Marias, Vanderlei Cruz, Davide Fonseca, Marius Stef

139 5.4. Notes from the round-table moderator
Luís Carlos Carvalho Pires

143 5.5. Proposal for development of a Methodology to support renewable energies use for isolated territories
Frédéric Marias

147 5.6. Assessment of wind resources with a focus on micro-generation applied on farmland in Portugal inland
Vanderlei Cruz

157 5.7. Assessment of renewable energy potential in UNITA territories: An initial reflection
Davide S. B. Fonseca

161 5.8. Research challenges in renewable energy across UNITA territories and beyond
Marius Stef

1. FOREWORD

As we get into this research workshop, it is both a privilege and a pleasure to welcome participants from the three-core thematic of Re-UNITA to this esteemed meeting at our Alliance. In an era defined by rapid changes, interdisciplinary collaboration, and global challenges, research has never been more critical. Thanks to this workshop, we are coming together not only to share knowledge but also to foster partnerships that will push forward our inquiries into the future.

This workshop serves as a unique platform to ignite conversations, promote connections between researchers, and explore the latest advancements in Re-UNITA's research activities. Our aim is to facilitate an environment where insights cross traditional boundaries, allowing participants to engage in meaningful dialogue and collaborative projects.

The success of our workshop relies on the active participation and enthusiasm of each attendee. We invite you to share your insights, ask questions, and engage fully in discussions. It is through collaboration, collective intelligence and knowledge sharing that research is going forward.

We extend our gratitude to UBI organizing committee and to all the contributors for their efforts in making this workshop a success. Your dedication to advancing research excellence within our alliance is invaluable.

Let us take this opportunity to connect, learn, and inspire each other. Together, we can prepare groundwork for research that not only addresses contemporary issues but also prepares the future.

Thank you for participating, and I look forward to an enriching experience for us all.

Warm regards,

Frederic Marias, Re-UNITA Project Coordinator, University of Pau and Pays de l'Adour

2. EXECUTIVE SUMMARY

This e-book is a comprehensive compilation of insights, findings, and research challenges derived from the workshops on Cultural Heritage (CH), Circular Economy (CE), and Renewable Energies (RE) under the Re-UNITA project, which were held at the University of Beira Interior from 18th to 19th April 2024.

Addressing pressing societal challenges through multidisciplinary approaches, Re-UNITA aims to foster collaboration, innovation, and knowledge exchange among UNITA universities in close relationships with different stakeholders and to energize the surrounding territories. The CH, CE and RE workshops, part of the Re-UNITA WP2 Task 2.3 activities, brought together experts, academics, students, and professionals from various research fields to engage in project presentations, dynamic discussions, and collaborative round-table sessions. The events focused on key research topics in the different research areas that impact rural and mountain areas and covered the concepts of sustainability, digital transition, and social inclusion, among others.

The e-book compiles the collective knowledge generated during the workshops. It includes the contributions from the participants in Part I sessions – Presentation of research projects (8), and the discussion topics in the Part II Round-table sessions (16). Overall, details of ongoing projects, summaries of discussions, and key takeaway messages are provided.

This e-book is a valuable resource and a testimony of the impactful outcomes of the Re-UNITA project in promoting collaborative research efforts across the UNITA alliance. It provides practical insights and strategies that can be applied across various contexts to drive positive change, empowering our community to develop the UNITA research identity further.

Sílvia Socorro, Vice-Rector for Research, Innovation and Development, University of Beira Interior

3. FROM THE CULTURAL HERITAGE WORKSHOP

PART I. Research Projects in Cultural Heritage

3.1. Research Projects at the ITEM laboratory of the Université de Pau et des Pays de l'Adour in Cultural Heritage of Mountain Areas

Dénes Harai*
University of Pau and Pays de l'Adour - ITEM Laboratory - Identities, territories, expressions, mobilities

The ITEM laboratory (Identities, Territories, Expressions, Mobilities) brings together scholars from various fields of Humanities (History, Art History, Archaeology, Anthropology, Iberian civilisation). It covers various research themes from medieval times to present day and impulses a great number of projects in the humanities, especially in the perimeter of cultural heritage, at international, French, regional, local scales and also in partnership with the private sector. The members of ITEM act as leaders or as partners in these projects, both in tangible and intangible cultural heritage of mountain areas, especially in the Pyrenees, with a European outlook and comparisons.

In many cases, the research carried out deals partly or entirely with key issues of our times, such as mobilities in the context of socio-politic evolutions; infrastructures in the context of economic transformations; landscapes in the context of climate change. Re-UNITA boosted the involvement of scholars from ITEM in cultural heritage studies, strengthened already existing cooperations and created a stimulating context for new ones. This paper's ambition is to give a comprehensive overview of ongoing projects as well as to put forth fields and topics in which ITEM could foster partnerships with laboratories from other universities of the UNITA alliance.

Projects on tangible heritage

Projects on tangible heritage include research on written heritage through archival records, especially those of the late medieval age and of early modern times (14th – 17th centuries), on built heritage of the modern era (19th-20th centuries) linked to health and to leisure infrastructures (spa towns and ski resorts) and on industrial heritage of mountain areas such as small infrastructures of hydroelectricity (20th century).

Written heritage

Research on written heritage encompasses different approaches (material, archival, codicological, historiographical) of various manuscript documents issued between medieval times and the modern era in order to shed light on societies and states in mountain areas. The research conducted on these patrimonial writings adopts mainly cultural and socio-political points of view.

Inventories of family archives are of a particular interest to Dr. Véronique Lamazou-Duplan who scientifically led the *Archives de famille en péninsule ibérique (fin du XIIIe siècle – début du XVIIe siècle)* international project (École des Hautes Études Hispaniques et Ibériques / Casa de Velázquez, Université de Pau et des Pays de l'Adour, Universidad Pública de Navarra, Universidad del País Vasco, Universidad de Girona, Universidad Nova de Lisboa) and edited *Les archives familiales dans l'Occident medieval et moderne. Trésor, Arsenal, Mémorial* (Madrid, Casa de Velázquez, 2021, 555 p.), a collective volume covering this topic through more than thirty-four case studies presented by scholars from France, Spain and Portugal. Dr. Lamazou-Duplan continues to work on inventories as well as on chronicles of the 14th and 15th centuries, the field of specialisation of another ITEM member Dr. Pierre Courroux. These two scholars, along with Dr. Dominique Bidot-Germa, edited *Gouverner et administrer les principautés des Alpes aux Pyrénées, XIIIe – début XVIe siècle* (Bordeaux, Ausonius Éditions/ UN@ éditions, 2023, 291 p.) dealing with archives produced by rulers and administrators in various meridional principalities.

Royal deeds of an administrative nature are at the centre of the AcRoNavarre (*Actes royaux de Navarre, XVe-XVIe siècle*) project, supported by the French national research funding agency (Agence nationale de la recherche) and carried out by Prof. Philippe Chareyre and Dr. Dénes Harai, along with Dr. Álvaro Adot Lerga (Universidad Complutense de Madrid), in a

Franco-Spanish partnership (Université de Pau et des Pays de l'Adour, École des Hautes Études Hispaniques et Ibériques / Casa de Velázquez, École nationale des chartes, Conseil départemental des Pyrénées-Atlantiques / service départemental des archives, Universidad Pública de Navarra) between 2017 and 2023. Outputs of this project include two volumes on the practice of delegating power (Dénes Harai, Au nom de la reine. *Henri de Navarre, lieutenant général de Jeanne d'Albret, 1572*, Pau, PUPPA, 2019, 140 p. and Philippe Chareyre, Álvaro Adot Lerga and Dénes Harai, *Les alter ego des souverains. Vice-rois et lieutenants généraux en Europe et dans les Amériques, XVe-XVIIe siècle*, Pau, PUPPA, 2021, 479 p.), an exhibit catalogue (*L'art de régner. Les souverains de Navarre à la Renaissance / El arte de reinar. Los reyes de Navarra en el Renacimiento*, under the direction of Philippe Chareyre, Isabelle Pébay-Clottes and Paul Mironneau, Madrid / Pau, Casa de Velázquez / PUPPA, 2021, 255 p.) and two volumes by Philippe Chareyre, Álvaro Adot Lerga and Dénes Harai forthcoming in 2024 on institutions and their records at the Renaissance: *Princes, Conseils et Réformations à la Renaissance. Politique et Religion* (Madrid, Casa de Velázquez) and *Les souverains de Navarre au miroir des actes* (Pau, PUPPA).

Built heritage of health and of leisure

The ITEM laboratory has a strong track record in analysing the history and the art history of spa towns and of ski resorts in the Pyrenees.

In the footsteps of the TCV PYR (*Thermalisme, Culture, Villégiature dans les Pyrénées*) FEDER project implemented between 2017 and 2020 by a strong meridional consortium (Université de Pau et des Pays de l'Adour, Université Toulouse Jean-Jaurès, Université de Perpignan Via-Domitia, Inventaire général, Région Nouvelle-Aquitaine and Région Occitanie) in which they have played a key role, scholars of the ITEM laboratory pursue their research especially on spa towns. Prof. Laurent Jalabert, together with Dr. Nicolas Meynen (Université Toulouse Jean-Jaurès) and Dr. Esteban Castañer Muñoz (Université de Perpignan Via-Domitia), has recently edited *Patrimoine du tourisme thermal et de la villégiature en montagne des Pyrénées et d'ailleurs* (Toulouse, Presses universitaires du Midi, 2023).

Dr. Viviane Delpech deepens her research not only on spa towns, but also on the history of artistic interactions in the Pyrenees through projects in partnership with Universidad de Zaragoza funded by the Région Nouvelle-Aquitaine and the Gobierno de Aragon: *PatrimPublic: Études*

historico-artistiques transfrontalières pour la valorisation sociale du patrimoine comme ressource éducative et touristique in 2021-2022, with its edited volume Patrimoine thermal de la gloire au péril (Pau, PUPPA, 2023, 272 p.) by Dr. Delpech, and *PATMOS: Patrimoine historique et mise en valeur: socialisation et muséalisation (Pyrénées centrales, occidentales et autres territoires)* in 2023-2024 with its two one-day conferences held at Université de Pau et des Pays de l'Adour: *Voyages aux Pyrénées. Récits et représentations* (26 January 2024) and *Sombres Pyrénées. Récits et représentations* (8 March 2024).

Dr. Delpech is also leader of the POPSU (Plateforme d'Observation des Projets et Stratégies Urbaines) Eaux-Bonnes project, funded by the Ministry of Ecological Transition and Territorial Cohesion of France under the following title: *For a new life of the thermal heritage: resilience and mutations of a socio-economic activity at the service of the territory. Reflection and prospective on the spa town of Eaux-Bonnes*. In the Ossau valley and mostly known today because of the Gourette ski resort, Eaux-Bonnes is a community that possesses a remarkable architectural heritage of the 19th century which is partly in ruins due to several economic crises.

This context gives an opportunity to renew urban spaces and their uses at a time when society is questioning its relationship with the environment, working conditions and the liberal system, or with the body and its physical integrity. The project consists in a research-action focusing on means to reclaim the abandoned spaces, with the aim of safeguarding a rich and historic heritage while working towards the cultural, social and economic revitalisation of an entire valley. The population of Eaux-Bonnes, its elected representatives and the public and private stakeholders are brought together to optimize and to reconvert the architectural heritage of the spa town, key to a cultural and interterritorial solidarity in the valley.

Economic heritage

Beyond spa towns and ski resorts, members of the ITEM laboratory are also interested in the economic heritage of the Pyrenees and its foothills.

For example, in his project about small hydroelectric infrastructures in Nouvelle-Aquitaine, Dr. Julien Marchesi researches not only economic and industrial dynamics, environmental consequences on the landscape and processes of decision-making of public stakeholders and debates over the infrastructures and their uses, but also the process of patrimonialisation of

these infrastructures. As for this last topic, Dr. Marchesi looks into the notion of landscape of hydroelectricity, compares cases of its patrimonialisation in France and abroad, studies the mountain river and lake tourism and how it benefits from hydroelectric infrastructure and approaches hydroelectric machines and architecture as witnesses of the industrial history of the region. Among the foreseen outputs of this project, there are inventories of machines and of buildings, interviews with locals and tourists regarding their relations to hydroelectric infrastructures and exhibits based on the photos kept in the *Archives départementales des Pyrénées-Atlantiques*.

In addition to projects on cultural heritage in mountain zones, the ITEM laboratory has expertise in rural areas too, given the involvement of its scholars in the study of vineyards, as demonstrated by the *Petits vignobles aquitains* project led by Prof. Laurent Jalabert along with Stéphane Le Bras (Université de Clermont-Ferrand). Another example is the project on the history of infrastructures of the aeronautic industry, headed by Dr. Laurent Dornel (*Histoire des industries aéronautiques dans les Pays de l'Adour depuis les années 1930*). Therefore, the laboratory is open to cooperations in these fields too.

Projects on intangible heritage

The ITEM laboratory has two major projects on intangible heritage in the Pyrenees: one on dry stone techniques and another on the uses of natural resources by communities of the valleys. These projects illustrate the continuity in the study of phenomena (pastoralism, anthropization of mountains, etc.) that has been one of the research strands of the laboratory for decades.

PETRA POCTEFA project (2024-2026)

This project on the use, valorisation and diffusion of dry stone techniques in the transpyrenean area (Exploitation, valorisation et promotion des techniques de la pierre sèche dans l'espace transpyrénéen / Aprovechamiento, valorización y promoción de técnicas de piedra seca en el ámbito transpirenaico) is funded within the Interreg POCTEFA framework and implemented by a consortium covering the Pyrenees : CTP (Communauté de Travail des Pyrénées), IDAPA (Institut pour le développement et la promotion de l'Alt Pirineu et de l'Aran), PNRPC (Parc naturel régional des Pyrénées catalanes), PNRPA (Parc naturel régional

des Pyrénées Ariégeoises), Comarca de Sobrarbe, Universitat de Lleida and Université de Pau et des pays de l'Adour. Dr. Patricia Heiniger-Casteret, anthropologist, and Dr. Mélanie Le Couédic, archaeologist, are leading this project at the ITEM laboratory and they can also count on four associated partners: CIRDOC Institut occitan de cultura, Communauté d'agglomération du Pays Basque, Parc National des Pyrénées and Pays d'art et d'histoire, Communauté de Communes du Haut-Béarn.

The art of dry stone walling, knowledge and techniques was inscribed by UNESCO on the Representative List of the Intangible Cultural Heritage of Humanity in 2018. The part of ITEM laboratory in the PETRA project includes four tasks. The first one is the benchmark of tools and methodologies that can be used to cartograph, inventory and geolocalize dry stone structures in order to facilitate the drafting of a transpyrenean strategy and action plan. The second task consist in the cartography, the inventory and the geolocalisation of dry stone structures using homogenous criteria to classify them (margins, vineyard huts, walled caves, shelters, windbreaks, retaining walls, ponds, cisterns, etc.) according to their typology, use and heritage value. The third task is the digitization in 3D of a selection of dry stone structures and writing of a story map to enhance scientific outreach. The fourth task is about documenting the knowledge of dry stone techniques and presenting them at workshops.

Intangible cultural heritage as vector of development in mountain areas (2023-2028)

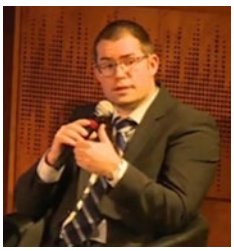
This project is carried out by Dr. Mathilde Lamothe, junior chair (*Patrimoine Culturel Immatériel comme levier de développement des TERritoires en zones de montagne, PCITER*) with the support of the French national research funding agency (*Agence nationale de la recherche*). Her research focuses on the identification and documentation of the know-how and the custom-based systems regarding three natural resources (water, wood, grass) that shape the sharing of space, as well as the rights and conflicts of their use. She is also interested in analysing the politics of use of the aforementioned natural resources. During the lifetime of this project, Dr. Lamothe will be also engaged in the evaluation of the strategies of transmission and of adaptation, as well as in the study of the factors of destabilization and of danger affecting communities in the valleys as they deal with their natural resources in times of crisis (changes in climate and society).

The first year of the project is dedicated to the organisation of a one-day conference on the commons in the mountains (*Équitables mais pas égalitaires. Les communs en milieu montagnard*, Pau, Université de Pau et des Pays de l'Adour, 19 April 2024) and to the preparation of publications and of an exhibit.

What's next?

The ITEM laboratory will continue the implementation of current projects by organising scientific events in academia (conferences, workshops, talks in the *Jeudis d'ITEM* seminar series) and in society (long tradition of participating in the European Heritage Days, European Archaeology Days, *Les Nocturnes de l'Histoire*, etc.), sharing their contents on paper and online. Colleagues from other member institutions of UNITA are associated or could be associated in these projects as well as in those to come, for example, regarding archives and patrimonial writings, migrations and mobilities of populations, ski resorts, etc. Finding fundings, whether at national, transnational or European levels, is and will be a key task. Already existing and future cooperations within the Re-UNITA network give a very good basis to tackle this important challenge.

The ITEM laboratory's intention is to stay highly involved in UNITA's cultural heritage initiatives in the future and to bring its best to the alliance's European success. The workshops organised by Universidade da Beira Interior on "Research challenges for Cultural Heritage, Circular Economy and Renewable Energies in rural and mountain areas" in Covilhã (18-19 April 2024) were a perfect opportunity to envision collectively the road ahead.



*About the Author:

Dénes Harai obtained his PhD in Early Modern History in 2009 at the Université Paris 1 Panthéon-Sorbonne with a comparative dissertation thesis on the advisors of the king of Navarre and those of the prince of Transylvania (16th-17th centuries). He is specialized in the study of politics and of culture during the Renaissance in Europe, especially in the Pyrenees and in the Carpathians. Since 2017, he has been a member of the ITEM laboratory at the Université de Pau et des Pays de l'Adour. Between 2017 and 2023, he had a key

role in the implementation of the AcRoNavarre (royal deeds of the rulers of Navarre during the 15th and 16 centuries) research project supported by the French national funding agency (Agence nationale de la recherche), in which he was a post-doctoral research fellow between 2017 and 2020. In 2021-2022, his second post-doctoral fellowship was part of the Interreg Atlantic Big Open Data for Atlantic Heritage. He currently works as project manager (ingénieur d'étude) accompanying the research projects of his laboratory and he continues research and publishing.

3.2. The Linked Open Data Cataloging System ACUSTEME. Semantic Interoperability in the Ethnomusicological, Musicological and Ethnographic Domain[1]

Giulia Ferdeghini*, and Ilario Meandri
University of Turin

Introduction

Among the ongoing projects in the field of Cultural Heritage and Humanities at the University of Turin, the one presented here concerns the elaboration, production, possible spin-off, and practical applications of a digital cataloging and native Linked Open Data (LOD) system, specifically designed for the ethnomusicological, musicological and for the ethnographic domain, carried out over the last five years by the teams led by Ilario Meandri.

The cataloging system is called ACUSTEME and it has been conceived and developed within two national grants, provided by the Italian Ministry of Culture, that pool together several Italian universities: namely the PRIN (National Project of Relevant Interest) "Heritage, festivals, archives: musical and performative practices of oral tradition in the 21st century", whose Principal Investigator was Giovanni Giuriati and lasted from 2017 to 2023; the PRIN 2020 "New Music Writing Processes for Cinema", whose P.I. is Roberto Calabretto, and is still in progress. A spin-off of this project has been accepted as a subproject of the bigger "Living Cabiria", founded by

_____

1 The authors developed this text cooperatively and therefore share its contents, methods and perspectives. This work was conceived as part of the research activities of the Turin Unit for the PRIN 2017 project " Heritage, festivals, archives: musical and performative practices of oral tradi-tion in the 21st century " (PI Giovanni Giuriati), PRIN 2020 project "New Music Writing Processes for Cinema" (PI Roberto Calabretto) and PNRR Living Cabiria" a project founded by the European Community PE5 CHANGES (Cultural Heritage Active Innovation for Next-Gen Sustainable Society) (SR Antonio Pizzo). Some of the content has already been published in Meandri, Ferdeghini, D'Amato (2022, forthcoming) and in Ferdeghini, Meandri (2023, forthcoming). The writing was as follows: Ilario Meandri wrote the paragraph entitled "The SAMIC project", Giulia Ferdeghini wrote the remaining paragraphs.

the European Community PE (Extended Partnership)5 CHANGES-Cultural Heritage Active Innovation for Next-Gen Sustainable Society- of PNRR (National Recovery & Resilience Plan) - Spoke 2-Creativity And Intangible Cultural Heritage and WP3 whose Scientific Responsible at the University of Turin is Antonio Pizzo.

In this paper, we present the motivations that led to the development of this new system, the theoretical principles and standards that stand behind and regulate the data model, the functioning of some parts of the data entry system, and, because a computational ontology will support the functioning of the system once in production, we provide here the method adopted for the ontology modeling.

Purpose and Goals

Enhancing the value of different kinds of archives is often neither a matter of massive digitization only, in case the materials were in analogical format, nor of storing, be it the case of digital archives. It is also a matter of finding methods and good practices for cataloging and sharing data and metadata, in order to make the records accessible and also fulfill the need of retrieving information most efficiently and as thoroughly as possible.

This is particularly true in the field of ethnomusicology where, as we shall see further on, the documents with which the researcher is confronted can be the most diverse.

For the purpose of making the cataloging and the retrieving of data more efficient, our team has been working on the ambitious project of building a native LOD cataloging system, specifically meant for the pertinent and consistent description of ethnomusicological, musicological, and ethnographic materials.

Together with the cataloging system, another targeted goal of these projects is the release of a computational ontology for the ethnomusicological domain, which should be used as a means for data exposure in the semantic web. Moreover, a third project, generated as a side project of a bigger one focused on the valorization and the re-enactment of a peculiar heritage of Italian historical silent film – namely Cabiria by Giovanni Pastrone, first released in 1914 –, has been working on a spin-off that aims using the ACUSTEME system for experimenting in practical applications in educational or museum presentational contexts.

The ACUSTEME project revolved around three main goals: 1) to create a catalographic system specially designed for the granular and pertinent

description of resources of ethnomusicological interest; 2) to provide an ontological representation of the ethnomusicological domain; and 3) to expose catalographic data in LOD. Currently, a fourth goal has been added, that is 4) to enhance the value of archive materials by elaborating innovative ways of fruition, such as live interaction with AI tools, and by generating deliverables that make use of the cataloging system to retrieve specific sets of data.

While developing ACUSTEME's data model, although leaning to Italian existing cataloging rules, we have been considering that our primary objective should not have been to create a new cataloging standard, but rather to develop tools that would enable various conceptual descriptive models to work together, each carrying ethnographic significance. This objective should also be viewed in the context of decolonizing archival practices, more precisely allowing various institutions settled in different parts of the world to describe 'emically'[2] their documents through the use of specific vocabularies, thesauri, and local terminologies without having to forcibly conform to descriptive standards imposed elsewhere or too peremptorily used as hegemonic guidelines.

The data model we built will also be supported by a domain ontology that will allow and facilitate the data search in the semantic web. This phase of the work is on the verge of being closed, as we are willing to release the ontology as soon as 2025.

Needs to fulfill

What are then the practical and technical needs for the project to fulfill?

The work of an ethnomusicologist, or that of a musicologist working for instance on film music, contemporary music writing, videogame music, acoustemology, soundscapes, etc., often involves dealing with a wide variety of documents, sources, resources, and media, such as musical instruments, archival records, photographs, microfilm, native-digital

[2] The 'ethic' (taken by the linguist Kenneth L. Pike from 'phonetics' and then generalized to the study of human behavior) approach in ethnographic or anthropological research means analyzing the phenomena from an external and physical point of view; whereas the 'emic' (from 'phone-mics') approach aims the understanding and thus explaining an observed culture from within, focusing preferably on the facts, concepts and phenomena pertinent to the studied cultural sys-tem, also using adequate local terminology to explain it.

documents, online resources, audiovisuals and so on. Within the Italian system of rules, these resources could find neither a proper standard of catalographic description (due to the heterogeneity of the cataloged content, the different types of media, and the different sensibilities and purposes of each conservation institution) nor a technological infrastructure with nationally shared cataloging rules for adequate research and localization of the resources. There is, in reality, a multitude of digital ecosystems and regional infrastructures, mainly represented by Content Management Systems (CMS) and Relational Data Bases Management Systems (RDBMS), each owning autonomous guidelines and established cataloging traditions. Heterogeneity is a rich for certain and at the same time a problem for the visibility, accessibility, and retrieval of resources.

While the digitization of documents is essential to allow wider access to rare and valuable material, stored in very specific and context-related archives, it is equally important that resources (digitized or not) and their metadata are made findable and available thus permitting a wider and open access also to those who may not be aware of their existence.

On the one hand, the need for researchers to track down useful resources wherever they may be stored is paramount, particularly in the field of ethnomusicology where resources of any kind are kept in various public institutions and private archival fonds around the world.

In Italy, we deal with three major cataloging systems driven by three central institutes Istituto Centrale per il Catalogo e la Documentazione (ICCD), Istituto Centrale per gli ARchivi (ICAR), Istituto Centrale per il Catalogo Unico (ICCU) that release and update descriptive norms and standards respectively for Cultural Assets, Archival Documents, Library resources.

The work of ethnomusicologists and musicologists, who strides with great flexibility among different kinds of resources, media, and contents might be hindered by this kind of partition that surely is efficient in categorizing and describing documents and assets, but is not efficient in linking those that share domain-specific relationships and need domain-specific descriptors.

The lack of shared standards is mainly due to the fact that until very recent times the preservation and conservation institutions created their archival databases by building closed proprietary systems, but this has had – and still has –, many drawbacks, the main two being technological obsolescence and digital data dispersion. On the one hand, once system

updating ceases the system itself may disappear from the digital domain and stored data would no longer be available. On the other hand, whenever a data provider adopts its own rules of access and record definition and does not make use of a unified access point, this does not allow for interlinking and relating datasets that may exist in independent digital domains but could still be put in relation, while instead related catalographic data, would allow for considerable mutual enrichment of datasets and databases. What we strongly believe to be a solution to this issue is to embrace the LOD technology and the principle of FAIR data that consists in making it Findable, which means tracking down useful resources, Accessible, allowing wider access to data, Interoperable, that is possible if data are linked and open access, Reusable, through sharing standards for specific description that implies using, reusing or modeling suitable ontologies.

The SAMIC project as a starting point

As far as what concerns the Italian context, the first application of LOD technology in the field of ethnomusicology was successfully carried out within the "Sound Archives and Musical Instruments Collections" project (SAMIC 2016-2019), led by Ilario Meandri and his research group (Meandri and Ghilardini, 2019). SAMIC achieved a few practical goals, being the first open-source national CMS and LOD system dedicated to the digital cataloging of musical instruments. SAMIC was used for the cataloging of a large and uncommon collection of musical instruments preserved in the "Museo del Paesaggio Sonoro" in Riva presso Chieri (TO) of which a digital library was then created. A second result was to make interoperability possible, i.e. the possibility of sharing data with other existing museums and archives in Europe. The Department of Humanities of Turin, acting as an intermediary for the MPS, is therefore data provider for the European consortium Musical Instruments Museums Online (MIMO)[3], this means that the cataloging data are periodically shared through the OAI-PMH protocol, Open Archives Initiative for Metadata Harvesting. Figure 1 shows how the linking of semantic data works: through the sharing of a common ontology the MPS database and the MIMO database can retrieve and expose the same metadata and datasets so that what has been cataloged and stored in MPS can be retrieved from MIMO – in this case a hunting call for jays.

[3] https://mimo-international.com/MIMO/ [last viewed April 30, 2024].



Figure 1. Interoperability between MPS and MIMO

Furthermore, SAMIC structured the data model according to the current Italian standards, in particular the one proposed by the ICCD (Central Institute for Catalogue and Documentation – part of Ministry of Cultural Heritage, Activities and Tourism (MiBACT): the "Scheda Musica" (ICCD-SM 4.0) for the description of musical instruments, that was formulated by late Febo Guizzi, full professor of Ethnomusicology at the University of Turin.

Starting from this gained know-how, the Turin team, expanded the idea to other domain resources, such as non-published fieldwork materials, specific digital documents, objects, and needless to say archival and book materials, and thus generated ACUSTEME.

The importance of LOD, semantic web, and computational ontologies

In the present writing, it is not possible to go into deep technical details regarding LOD, nevertheless, it seems important to explain how it works to understand the enormous potential and intrinsic benefit of this technology in the field of digital humanities.

By way of illustration, let's consider the geographic location of resources or other cataloging items. Within a closed dataset, it would be possible to create a control authority system to ensure the truthfulness, consistency, and permanent updating of data, this mechanism would soon be out of control and unable to handle the amount of data and the speed of its accumulation. Since data is to be accumulated much faster than it can be checked and validated, this method proves inefficient, its feasibility would quickly be undermined, and entropy would arise with overcrowding and confusion of repeated or unverified erroneous data. The alternative

suggested by World Wide Web Consortium (W3C) is to delegate external repositories (open Knowledge Bases) to the management and permanent updating of data so that it can be extracted when and where required. Such repositories are often domain-specific, as it is the case of specialized databases (authority services), and managed by a community of qualified users, who are constantly updating and monitoring the data. Cataloging institutions and resource centers are thus disengaged on the one hand from having to locally store secondary data (i.e., related to other knowledge domains) and on the other hand from performing the data control work that has already been done upstream by the external knowledge base. At the same time, this system allows a wider capacity for collecting specific, accurate, and up-to-date information while increasing its quality and quantity. For example, when dealing with placenames it is possible to retrieve data from specialized repositories using Uniform Resource Identifiers (URIs), instead of relying on free text strings. This is because the text is prone to typos and can be affected by graphical variations caused by different sources of information or the language used by the cataloguer. GeoNames, for instance, is a geographical database that locates exactly over 11 million placenames through coordinate systems downloadable free of charge. In Figure 2, it is possible to evaluate the potential of this kind of retrieval when dealing with a very popular place spelling, and how easy the disambiguation can be if dealing with LODs.

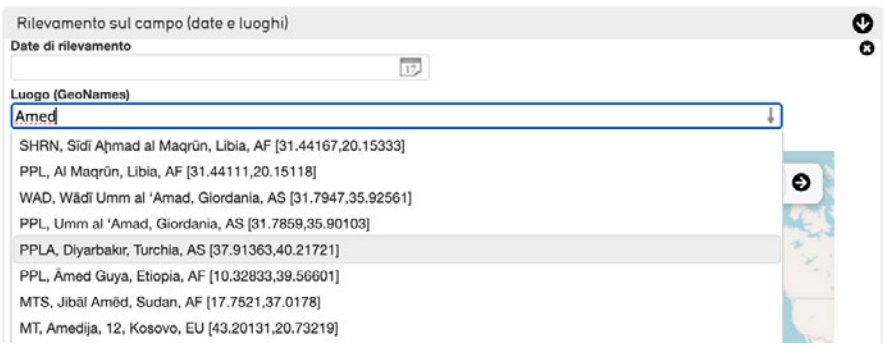


Figure 2. The retrieving of the correct place, among several places with similar or identical spelling

This is why the W3C promotes the advancement of semantic web technologies. This environment encourages LOD databases to organize

knowledge systems to make domain-specific semantics explicit and shared. This makes the information reusable outside of the local system[4].

The implementation of semantic technologies in the activity of digital cataloging and in the management of archives and databases is beneficial because it makes it possible to integrate semantic data from different sources and to link together either data belonging to the same domain or belonging to various other domains of knowledge.

The rapid spread of authority services and open, shared databases also grants a considerable amount of data curation by domain experts. One such database is Wikidata, the free and collaborative knowledge base that is part of the Wikimedia Foundation's project, and is one of the largest and best-known knowledge bases, offering a wide availability of items uniquely qualified through Qs (URI).

Data curation is another main and very sensitive topic among semantic web technologies, and it's fundamental to increase the value of shared data because the contribution of the global scientific community from different fields of research is utterly valuable to gain the aforementioned truthfulness, consistency, and permanent updating of data.

The fundamental innovation of semantic web technologies is to network materials and data and to create access points that enable their retrieval. This is possible through the use of computational ontology technology. A computational ontology can be defined in various ways[5], among which we pick Studer et al.'s (1998) elegant definition «A formal, explicit specification of a shared conceptualization». This can be briefly enucleated as follows: an ontology is a set of formal definitions of concepts, which are called Classes and Subclasses, and of relationships between these concepts, which are called Object Relations, expressed in a formal language such as RDF[6]. Computational ontologies are used to represent taxonomies in different knowledge domains and can be used for semantic search, data integration and interoperability, natural language processing, and application in systems that require semantic, namely machine-based, understanding of data.

_____
[4] See <https://www.w3.org/2001/sw/ > [last viewed April 30, 2024].
[5] See for example Gruber (1993) and Yi, Ho-fung & Ching-man (2012).
[6] The Resource Description Framework is one of the most popular and widespread W3C standards. It is used to represent information on the semantic web in a structured and interoperable way across different applications. See: < https://www.w3.org/2001/sw/SW-FAQ#whrdf> [last viewed April 30, 2024]

In other words, an ontology represents a basic logical structure through which the Knowledge Base is organized. The alignment of multiple ontologies allows for the rapid retrieval of increasingly specific information, while at the same time enabling the ability to move among different semantic fields through data connection. An ontology can also be referred to as a 'discovery tool', that helps create information.

While modeling the ontology for ACUSTEME, we strongly based on some tested modeling methods one of the most valuable of which was described in Beretta (2022) and was implemented in CIDOC-CRM ontology[7].

We are presently building an ontology for the ethnomusicological domain as represented by ACUSTEME's data model, which, as previously said, is strongly based on the Italian cataloging rules, but at the same time, as widely and warmly suggested by literature on the topic, we are concerned with the alignment with other widespread ontologies. The main three being the International Counsel of Archives (ICA)'s RiC-O (Records in Context Ontology) – of which ACUSTEME is an early adopter – which is focused on the description of archival resources; Library of Congress's BIBFRAME based on FRBR and implementing IFLA Thesauri for the description of library resources; and finally, the International Council of Museums (ICOM)'s CIDOC-CRM (International Committee for Documentation – Conceptual Reference Model) that is being widely used in museum contexts.

When it comes to ontology modeling, we prefer to use modularization as a technical tool. This means breaking down the ontology into smaller, more manageable parts that can later be integrated and connected. Modularization also allows you to use the patterning method described, among others, by Carriero et al. (2021)[8].

One of the biggest difficulties, while modeling an ontology is class detection which is precisely deciding what concept should be a class and, moreover, what specific and essential characteristics an item should have to be considered a member of that class. In this respect, some other concepts, through which we cannot go in-depth here, such as fuzziness and typicality are useful in ontology modeling. They can help define and refine the limits of each class and allow for a better description of context and domain[9].

_____

[7] On ontology modeling there is a flourishing literature among which cfr. Hammar et al. (2017), Carriero et al. (2021).

[8] See also: http://ontologydesignpatterns.org/wiki/Main_Page [last viewed April 30, 2024].

[9] On this specific subject see Yi, Ho-fung & Ching-man (2012).

ACUSTEME's functioning

Acusteme can catalogue various types of bibliographical, archival, and cultural heritage resources. It was implemented through the CMS Collective Access[10] that, through different user profiles, supports parallel cataloging by multiple institutions. We created an experimental profile template for the domain of ethnomusicology with specific description fields for musicological and ethnomusicological documents and materials, considering the media format, the recording & production technologies as well as the content. In Italy, there was no comparable data model available to provide such a detailed description of these resources, this is, we believe, a strength of the system that helps describe materials that would otherwise be "mute archival objects".

Cataloging such a variety of resources can be very challenging. Moreover, the long tradition of cataloging practice and theoretical thinking on cataloging methodologies, not to mention the incredible amount of items that have been cataloged during the decades, were impossible to ignore. That is why ACUSTEME tries, with some ambition, to integrate the three main systems of thought and catalographic practices.

Trying to address the specific issue of describing the 'aboutness', the 'subject', of a cataloged resource, the latest ACUSTEME data model, resulting from a long-term development, integrates the standards mentioned above and is powered by a set of controlled vocabularies, which can be extended by the cataloger directly from the back-end interface. To ensure a high level of interoperability, accessibility, and persistence to the most significant controlled vocabularies in the domain, we also experimented with an externalization process that relies upon the Wikidata platform, which currently collects more than 100 million entities. For this purpose, Collective Access is equipped with a plugin that allows querying Wikidata's SPARQL endpoint: through which one can directly tap into Wikidata's knowledge base where ACUSTEME vocabulary terms are represented and defined in a specific Focus List and through ad hoc properties.

The ethnomusicological domain, on which the Conceptual Model of Acusteme is designed and to which the ontology will correspond once completed, consists of several entities (Meandri, Ferdeghini, D'Amato 2022):

_____
[10] Please find it here https://www.collectiveaccess.org.

1) Field research materials in any format and medium, including notes, photographs, films;
2) Musical instruments;
3) Published materials (book materials and non-book materials) in any format and medium;
4) Description of field research campaigns (dates, geographical locations, agents);
5) Support description of agents (individuals, families, institutions);
6) Specific descriptors pertinent to the ethnomusicological domain, affecting each type of resource so far listed allow its catalographic description or annotation, i.e:

(a) Information on anthrotoponyms (ethnic groups, demonyms, nationalities, geo-cultural areas);
(b) Information related to musical phenomena (scales, modes, local names of voices, musical genres, vocal or instrumental ensembles, etc.);
(c) Information related to choreographic phenomena (local names of dances, choreographic elements that make up a dance, etc.);
(d) Information about objects and paraphernalia that are part of the ritual or that are utensils in some way related to musical practices or knowledge.

Domain-specific descriptors are part of a very articulated and complex system of which we will only briefly describe some aspects here. Through the data entry interface main page, it is possible to select the new element to be created Figure 4).

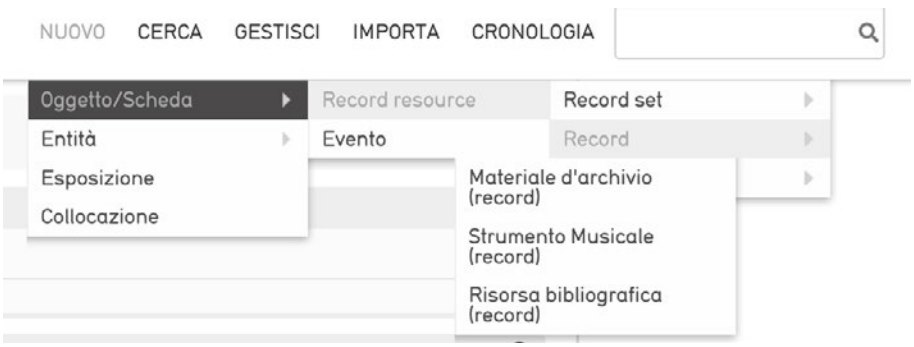


Figure 4. Acusteme's data entry menu

Assuming choosing a Record that is also a Bibliographical Resource, it is possible to thoroughly describe it through the various screens and

metadata, that align with the Italian standards for library record description (ICCU's REICAT and RMNP)[11]:

In the "Descrizione Fisica" (Physical Description) and in the "Dati Specifici" (Specific Data) screens it is possible to make an extremely granular and fine description of the kind of carrier, analogic or digital, to be cataloged (Figures 5, 6 and 7).

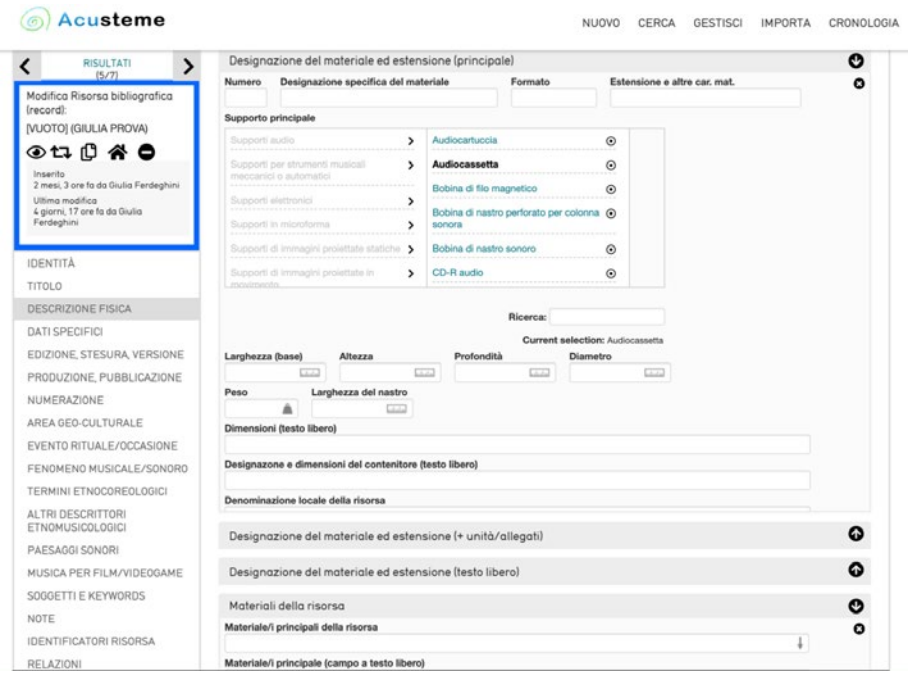


Figure 5. The "Descrizione Fisica" (Physical Description) screen

[11] REICAT (Regole Italiane per il Catalogo, Italian Rules for the Cataloging) and OPAC SBNRMNP (Risorse Musicali Non Pubblicate, Non Published Musical Resources) are the fundamental stand-ards through which it is possible to describe library resources and specifically musical ones. See < https://norme.iccu.sbn.it/index.php?title=Norme_musica_non_pubblicatahttps://www.iccu.sbn.it/export/sites/iccu/documenti/2015/REICAT-giugno2009.pdf> and < https://norme.iccu.sbn.it/index.php?title=Norme_musica_non_pubblicata>.

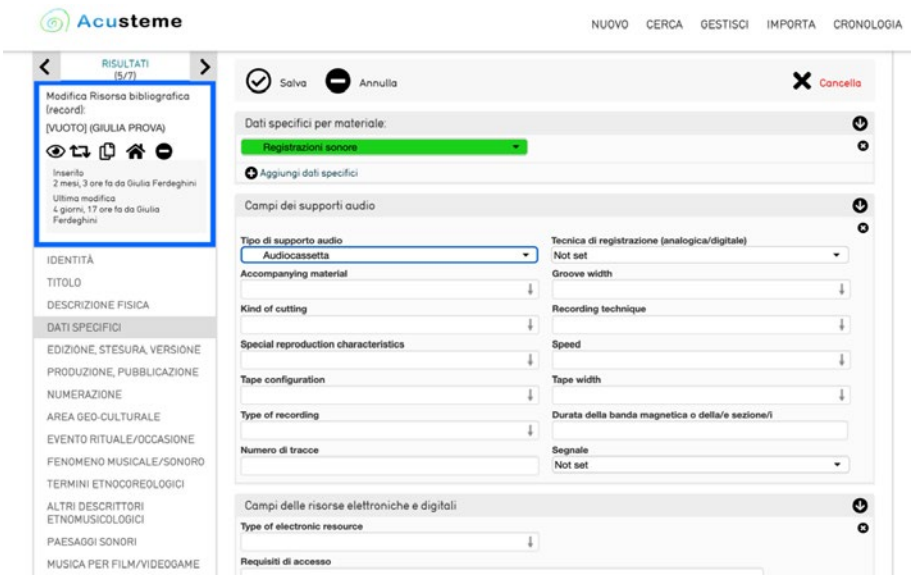


Figure 6. The “Dati Specifici” (Specific Data) screen for analog carriers

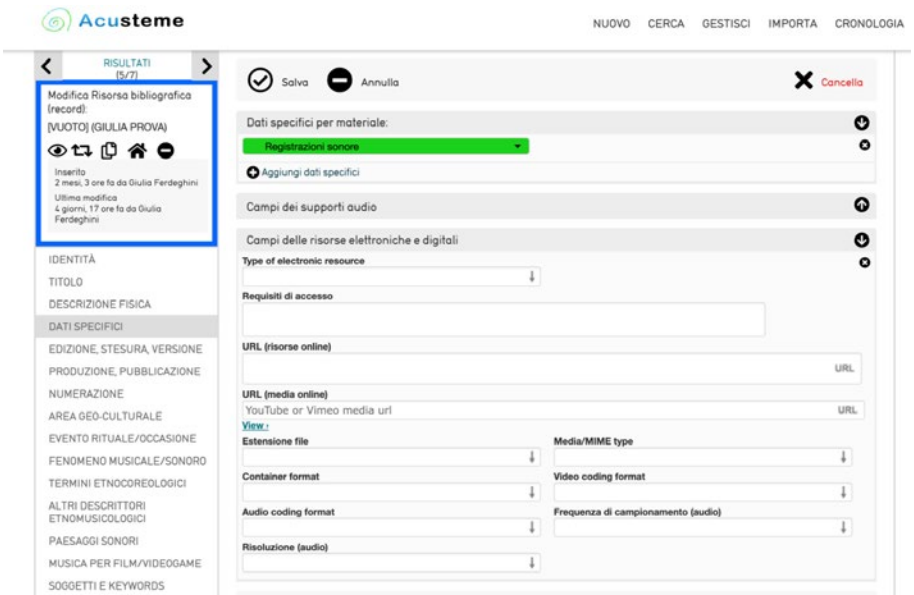


Figure 7. The “Dati Specifici” (Specific Data) screen for electronic and digital carriers

The "Area Geo-culturale" (Geo-cultural area) screen consists of repeatable fields that describe Demographic groups, Geographical areas, Nationality, and Language, mentioned in the cataloged resource. Thanks to a SPARQL query, data are collected from Wikidata (and related controlled vocabularies), therefore the description is as granular as it is the information available on the knowledge base. The Language field works in the same way and retrieves information controlled by an ISO standard (Figure 8).

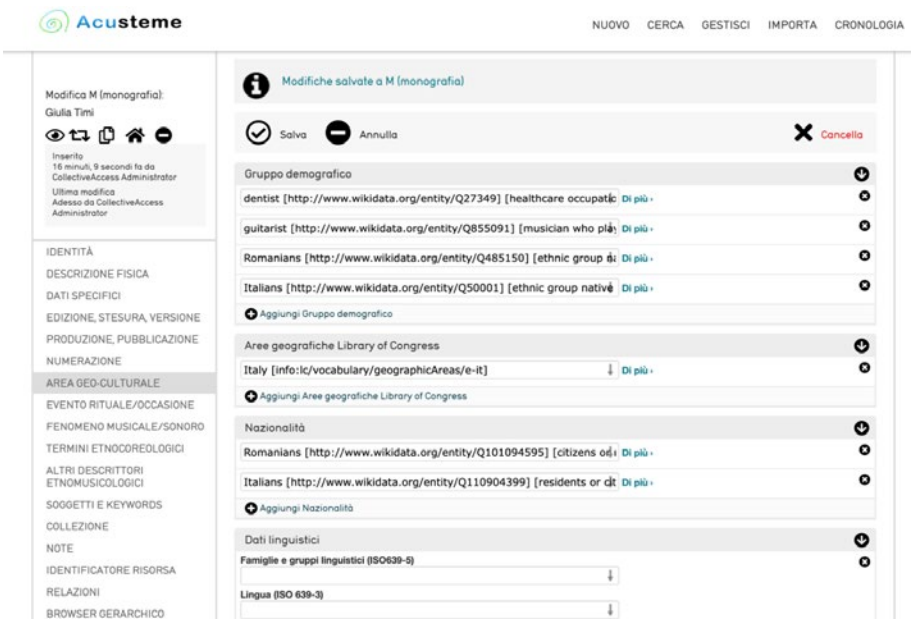


Figure 8. The "Area Geo-culturale" (Geo-cultural area) screen

The "Paesaggi Sonori" (Soundscapes) and Musica per film/video game ("Music for Film/Videogame) screen have only recently been introduced in the system as part of the latest projects and allow for the description of soundscapes following Krause and Gage's taxonomy (Krause 2015,) and for the description of film music cues (which are a very specific kind of document, very poorly considered from the descriptive standards so far Figures 9 & 10).

The remaining screens go deeper into the description of various other aspects we will not discuss here.

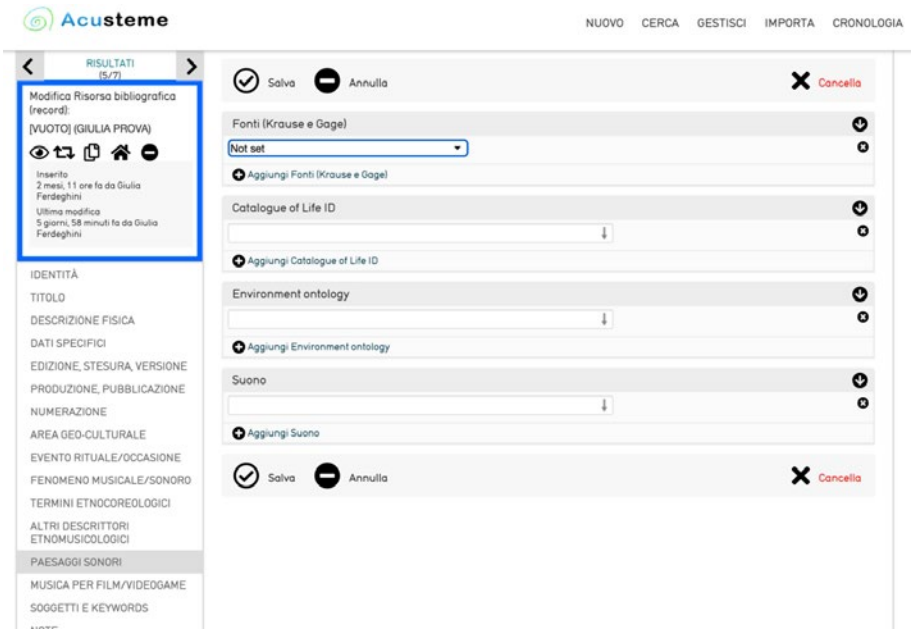


Figure 9, The “Paesaggi Sonori” (Soundscapes)

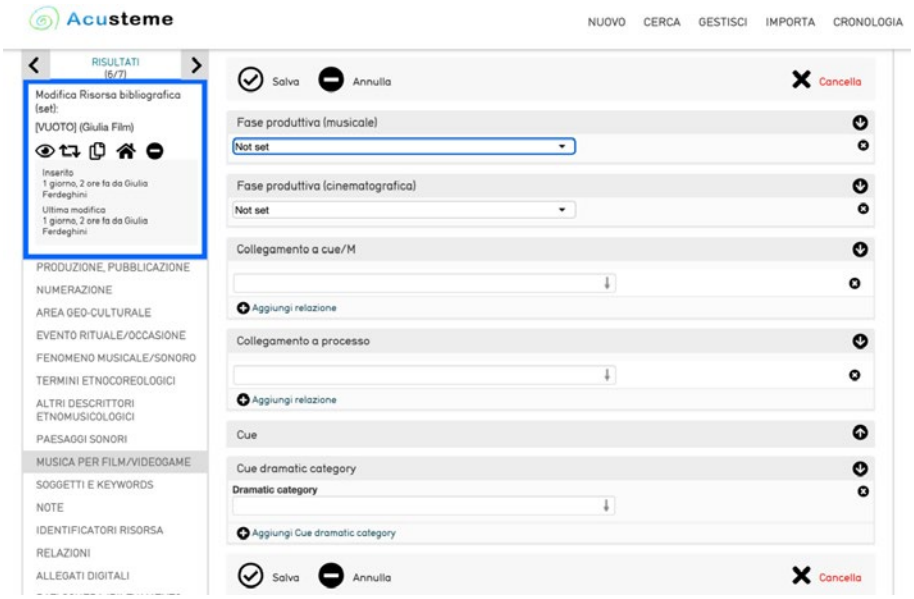


Figure 10. Musica per film/video game (“Music for Film/Videogame) screen

Among the extra-features of ACUSTEME, thanx to a special technology already tested in the SAMIC project, it is possible to attach 3D images for cataloging objects, such as musical instruments.

Current state of the project and future goals

Presently the team is working on the development of a beta version of the data entry system and on the release of the domain ontology. The system is also being translated into English to expand usability. In parallel, we are carrying out the testing phase which will continue until the release. The testing of ethnomusicological descriptors is partly taking place by experimental cataloging of some materials gathered from a few institutions that agreed to be our stakeholders.

In the short to medium term, our objectives revolve around several key areas. First, we aim to identify and engage additional stakeholders beyond those who have trusted us so far. This objective ties in with the need to create partnerships and networks that can support our initiatives. In addition, we are focusing on the data curation of some focus lists of specific terms. We are developing and releasing a beta version of our data entry system of which we will provide open access, making both the ontology and the ACUSTEME data entry system freely available to the public we are also developing a local portal model to allow users to see and browse data. All of this will facilitate collaboration and knowledge sharing within the research community. Finally, in the long term, we aspire to expand this idea on an international scale through participation in projects and networking that will allow us to exchange ideas, collaborate on research initiatives and contribute to global progress in the valorization of archives.

References

Beretta et al., 2022. Principles for Modelling Ontologies: A Short Reference Guide, Parthenos / ICS-FORTH, l.u.

Carriero Valentina Anita et al. 2021, "Pattern-based Design Applied to Cultural Heritage Knowledge Graphs", in Semantic Web (on line) - 12:2(2021): 313-357.

Ferdeghini Giulia, Meandri, Ilario, 2023, "Acusteme. Dagli standard di catalogazione nazionali al web semantico. Modellazione dei dati e costruzione di ontologie computazionali per l'etnomusicologia", in Suoni & Culture (in corso di pubblicazione)

Hammar et al., 2017, Advances in ontology design and patterns, Amsterdam (Netherlands), IOS Press.

Krause Bernie, 2015, Voices of the Wild, Animal Songs, Human Din, and the Call to Save Natural Soundscapes, New Haven, CT: Yale University Press.

Meandri Ilario, Ferdeghini Giulia, D'Amato Lianna, 2022, "L'Etnomusicologia nel Web Semantico", in Etnografie Sonore (in corso di pubblicazione).

Meandri Ilario, Ghilardini Cristina eds., 2019, SAMIC. Sound Archives & Musical Instruments Collections. Documentazione e guida al sistema catalogazione, Lucca LIM.

Yi Cai, Chin-man Au Yeung, Ho-fung Leung, 2012, Fuzzy computational ontologies in contexts : formal models of knowledge representation with membership degree and typicality of objects, and their applications, Beijing, Springer.

Online resources

W3C

<https://www.w3.org/2001/sw/ >

The Ontology Design Patterns
http://ontologydesignpatterns.org/wiki/Main_Page>

Iccu cataloging rules https://norme.iccu.sbn.it/index.php?title=Norme_musica_non_pubblicatahttps://www.iccu.sbn.it/export/sites/iccu/documenti/2015/REICAT-giugno2009.pdf
https://norme.iccu.sbn.it/index.php?title=Norme_musica_non_pubblicata

Collective Access

https://www.collectiveaccess.org

MIMO
https://mimo-international.com/MIMO/

***About the Author:**
Giulia Ferdeghini is a research fellow and ethnomusicologist at the Department of Humanities

at the University of Turin. Her work focuses on Linked Open Data and knowledge representation systems in the field of ethnomusicology and silent film music. She also teaches Ethnomusicology for the DAMS degree course at the University of Turin. Her area of expertise is the musical culture of the Kurdish people, she a specialization in the sung epic in Iraqi Kurdistan. She has recently published a book titled Beyta Dimdim: storia, struttura e analisi di un canto epico curdo (Beyta Dimdim: history, structure, and analysis of a Kurdish sung epic, LEVI 2024). She participates in the activities of a research group sponsored by the Ugo and Olga Levi Foundation on Kurdish epic and narrative singing.

3.3. Food Heritage: from Scientific Research to Academic Education. A case study: Universitatea de Vest din Timișoara (Romania)

Otilia HEDEȘAN and Dana PERCEC*
West University of Timisoara

First step: The Research Project FOODie[12]

The research project we would like to present was a Romanian national project involving 4 universities (West University of Timișoara, "Ștefan cel Mare" University of Suceava, "Vasile Alecsandri" University from Bacău and University of Craiova) and 2 research institutes (The Romanian Academy Branch Cluj-Napoca and the Institute of Ecological Research Tulcea). It is important to underline from the beginning that this was an extremely strong partnership: because the institutions participating practically covered the entire Romania, each of them being representative for a region, and, at the same time, complementary to each other.

There are several institutions that hold important archives of traditions from different historical periods (at the Romanian Academy Branch Cluj-Napoca there are ethnological field research documents from the first half of the 20th century, at the West University of Timișoara there are audio documents from the second half of the previous century). On the other hand, the "Vasile Alecsandri" University of Bacău had already started producing and publishing a series of short videos about the everyday food.

Five main activities took place during the project: field research, documentation activities in archives, this long series of activities such as transcribing interviews, editing audio and/or video tapes, classifying materials.

_____

[12] FOODie is the acrronym of the research project: Digital Collection of the Romanian Food Heritage and Transfer towards Society, (Colecție digitală a patrimoniului alimentar românesc și transfer spre societate) FOODie, PNCDI III, Programme 2, Subprogramme 2.1., PED (nov. 2020 – nov. 2022).

- ☐ Field research:
- ☐ Direct observation
- ☐ Ethnographic documentation thrue interviews
- ☐ Archive documentation
- ☐ Clasifing, organizing, transcribing & vieo editing of field research data;
- ☐ Results disseminating:
- ☐ Scientific publications;
- ☐ Scientific conferences;
- ☐ Knowledge transfer (thrue difital data bases: http://ecultfood.ub.ro/ /
- ☐ https://hera.uvt.ro/)

The project has also tried to deliver to the community information about food heritage, using two digital resources: http://ecultfood.ub.ro/ & https://hera.uvt.ro/. The two virtual spaces are, in fact, two big repositories where information is stored (sorted according to region /place of origin, dish name & when we received our informant's approval, specifying the informant's name).

The huge impact that our research materials (in general published on the internet) had on the community motivated us to better define FOODie (as a Food Heritage Project). Thus, FOODie was defined as: an ethnological / anthropological research; an incipient Romanian food heritage repository; „une madelaine" & an agregate of an interpersonal network. We would like to underline the importance of the memorial function (which we have called using the French word madlene and, of course, its literary backgruond); the idea is that the stories of our informants have always been linked to these memories of their own lives, of their families and/or of their communities.

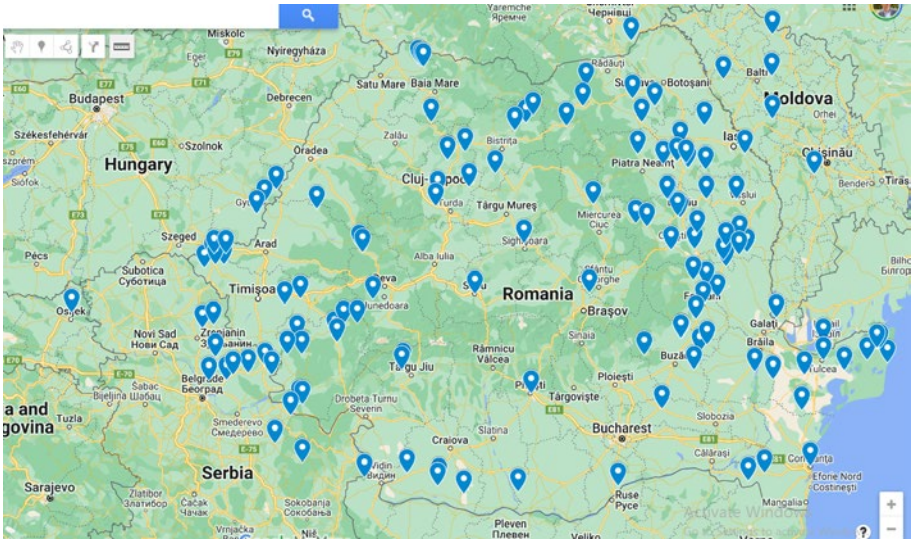
At the same time, we have reached the conclusion that FOODie is not: a cooking book; a cooking tutorial website; a short list of traditional dishes & / or cooking techniques.

During the project, several conferences were organized, but one of the most important scientific activities was the publication of a thematic issue in the Transylvanian Review: Multivalent Research about Food, Building the Romanian File, Transylvanian Review, (XXX, Supplement No. 2, 2021, 313 p., ISSN 2067 – 1016). As noted in the brief introduction to this "thematic file", "the question we asked and we try to answer in the texts of this issue of the journal is: What is the image of Romanian social and humanistic studies seen through the thematic lens of the anthropology od food and eating?"[13]

_____
[13] Otilia Hedeșan, Cosmina Timoce-Mocanu, Editors`s Note, in Multivalent Research about Food. Building the Romanian File, in `Transylvanian Review~, XXX, 2021, p. 7.



FOODie has provided the institutional framework for caring out a large amount of research. The map below is an obvious visual proof of the territorial spread of investigated local communities. Consequently, we are not only referring to the quantity of information, but also to the geographical coverage of our investigation.



In terms of numbers, FOODie also meant a large number of people willing to contribute in knowledge sharing. Thus, we interacted with a large number of informants despite the Covid 19 Pandemics[14]. It was this very social context that facilitated the adoption by our team of digital ethnology working methods.

Going further: *Food-Related Narratives of Survival: A Case Study of One of the First Blended Intensive Programs in UNITA*

The thematic school Randopat-Heritrail – Mushrooms, Herbs and Raw Food; Practices and Beliefs was one of the first Blended Intensive Programs organized in the UNITA alliance at the West University of Timișoara, between 7-11 November 2022, with 18 participating students (Master and PhD) from UPPA, UNITO, USMB and IPG, who were joined by 20 PhD students in Letters and History from the doctoraal school of humanities st UVT.

It is worth mentioning here, as a follow up of the first subchapter of this study, that the program was a successful example of dissemination of the project FOODie. The starting hypothesis of the thematic school was that food is an important component of cultural heritage, with all its derived forms of manifestation (environmental awareness, practical know-how, traditional calendars of customs and holidays). While this observation applies to all types of communities and groups, the regional and local element sheds valuable light on practices, techniques and beliefs related to the process of food production, preparation and sharing. Observing these processes, in a synchronic manner, but also diachronically, can be an ideal form of student training, as it also includes the intergenerational component.

While the region on focus during the thematic school was Banat, comparative references were encouraged for other regions of Romania, as well as the native regions of the student participants. An obvious similarity that students were urged to note was the importance of food which is obtained directly from nature, together with the consumption of herbs and vegetables, cultivated by the families, or hand-picked from the immediate surroundings. Another important observation and conclusion to be reached was the dynamic relation between common traditional knowledge –

[14] More details in Otilia Hedeșan, Cosmina Timoce-Mocanu, Réinventer le terrain ethnologique dans le contexte de pandémie de Covid 19 (Reinventing the Ethnological Fieldwork in the Context of the Covid-19 Pandemic), in "Trasilvania", 2023, no. 11-12, p. 109 – 117.

information accessible to everyone (such as the rhythms of planting, growing and picking various plants) –, and the knowledge controlled only by small or isolated communities, respectively information which is accessible only to a few connoisseurs (such as that related to picking mushrooms, mushroom varieties, their preparation; knowledge of herbs with therapeutic and/or culinary utility, knowledge of fruits, their cultivation, use and preparation).



An important illustration of this finding, which also became a starting point for a challenge launched for the students, was the presentation of an interview with a local Romanian native from Serbia, who was an informant during the field research carried by the team for the FOODie project. Milosava Grozdić presented recipes of specific regional food and techniques for successful mushroom picking, but she highlighted other, more particular aspects of the special knowledge one needs to prepare food, which is derived from a healthy relation with the environment: "In the countryside, in the woods, if you want to make food from what God has given you to roast and boil, but if you know how to use..." (transl. ours). She also talked about finding nutrition in extreme conditions, in situations of crisis: "The old men had salt stones in their pockets, they didn't go anywhere without them... And in the war, the soldiers had salt in their pockets, they licked a little salt, drank water and were full even if they didn't eat. [If you have such a] stone with you, you grind it, you put it on mushrooms and you have food, you feel sated." Milosava's story provides detailed evocations of frugality, difficult living conditions and hard times, but also makes us aware of the ways in

which traditional communities pass on a legacy of facing exceptional, crisis situations.

This led the team of teachers and researchers to offer the students participating in the thematic school the following challenge: to identify narratives (works of fiction, diaries, memoirs, historical accounts) on the topic of survival food (finding food in extreme conditions, preparing food in periods of crisis, scarcity or famine, eating in nature, in improvised conditions).

For the sake of illustration, I will briefly focus on two Romanian texts that were identified as significant in this context, albeit for different reasons. The first is the travel book, On Mountain Roads, written in 1912 by Calistrat Hogaș[15], a canonical literary text for Romanian school children.

On Mountain Roads presents a vivid depiction of travel adventures with peculiar habits and practices, quite unique in Romanian literature, characterized by a remarkable linguistic and lexical corpus, appreciated by critics for its authentic evocation of the mountaineous regions of Neamț Mountains in Moldavia, its atemporal quality and relevant for our students given its well-defined and poignant culinary dimension. The students concluded that On Mountain Roads is a feast of thematic and linguistic complexity, that awaits to be explored and tasted.

The second text was the diary kept by Anița Nandriș-Cudla[16], a peasant woman from Mahala (a small village near Cernivtsi, Ukraine) who was deported by the Soviet army during World War II, when the Romanian Bukovina was annexed by the USSR. This peasant woman was separated from the husband and ill mother, whom she would never meet again, and, together with her three sons, survived in the Siberian Gulag for the next 20 years, in very difficult conditions, characterized by food deprivation, illness and work in an extremely hostile environment. Details related to food indicate that the deportees were fed very small quantities of food – only 300 to 700 grams of bread and water. The absence of vitamins in the regular diet caused many prisoners to fall ill with scurvy. Anița describes in her story how she and her children walked long distances to pick wild berries, which helped them keep this disease at bay. The manuscript was handed over by Anița in 1982, but, because of its political implications, it could only be published in Romania after the 1989 Revolution, by the well-

[15] Calistrat Hogaș, Pe drumuri de munte, CARTEX, 2023.
[16] Anița Nandriș-Cudla, 20 de ani în Siberia. Amintiri din viață. Humanitas, 1991, 2024.

known publishers Humanitas. The book drew a lot of attention – and was appreciated by the students – not only for the narrator's extraordinary talent of a story-teller, despite her lack of education, but also for its lexical uniqueness, blending regional Romanian language with Russian words.

An important conclusion drawn and, I would like to think, a value acquired by the students during this challenge, was an important legacy passed on by the older generations, very often neglected in today's globalized world, but no less essential: there are always, among the learnings from one's forerunners, solutions for survival in times of crisis.

***About the Authors:**



Otilia HEDEȘAN is a Romanian anthropologist, professor of Romanian Culture and Civilization at the West University of Timisoara. Since 2015, coordinator of the RHeA research Centre, as a space of inter- and multidisciplinary interaction of young scholars. (PhD or postdoctoral researchers). She carried out or / and she coordinated ethnological field research in Eastern European countries: Romania, Bulgaria, Croatia, Hungary, Moldova, Serbia and Ukraine. Her main areas of interest are: everyday life in multi-ethnic communities, folklore and popular mythology, storytelling and narrative genres, food heritage. She is equally interested in the history of Romanian ethnology in European context, in this framework, being preoccupied by the status of folklore archives in Romania (in particular those situated in the cross-border Banat region). She coordinates the Cultural Heritage hub at UVT in UNITA 2.



Dana PERCEC is professor of English literature at UVT. Her main areas of interest include early modern English theatre, Victorian fiction, cultural studies, gender studies. She is a member of several professional associations (Romanian Society for English and American Studies, European Society for the Study of English, European Shakespeare

Research Association, the Romanian Writers Union). She has published books and articles in the areas of Shakespeare studies, contemporary British literature and culture, reader response theory. She has coordinated a series on genre theory at Cambridge Scholars Publishers. She is a member in the editorial team of several indexed scientific journals (British and American Studies, Brukenthalia). She coordinated the Cultural Heritage team at UVT in UNITA 1.

3.4. Research into intellectual and cultural heritage: methodological experiments

Jacques Ibanez Bueno*
University Savoie Mont Blanc – LLSETI (Languages, Literature and Society: International and Cross-border studies)

What follows is the development of a project initiated in 2022, which I am making accessible to the entire UNITA alliance community by publishing large extracts in English.

The starting point of the research is an intellectual who died in 1986, little known in his native mountainous region of Savoie. Michel de Certeau is nevertheless internationally renowned, and his thought continues to enrich contemporary research on social communication in our societies. This personality is part of the cultural heritage of Chambéry in Savoie (French Alps). This city is in which my research group and the headquarters of my university are located. The research is taking advantage of a commemoration in 2025, the centenary of his birth, to question the relevance of his concepts when applied to today's digital communication, such as that on digital social networks.

Beyond the appropriateness of the cultural heritage framework, the research proposes to innovate on a methodological level. Experiments are being set up using multimodal methods. These collaborative methods call on participants' bodily expression, as well as the use of artificial intelligence. This research is at the crossroads of the visual arts and the social sciences. Collaborations have already been set up at UNITA, and new research players are welcome to join in.

My proposition is part of the continuation of research dedicated to research methodologies (current research axis within the LLSETI, the research group to which I currently belong) and to questions about the uses of digital communication, which cover my entire research career. This project is situated in an epistemological approach with methodological

practices called participatory (Bergold; Thomas: 2021), which require to approach subjects of a human group, in the perspective of an expression of the latter, to produce data in the service of research questions relating to the effects of the digital in society. The dominant theoretical framework is based on a contemporary rereading of a major reference, L'invention du Quotidien written by Michel de Certeau (1980), by applying it to the uses related to the digital.

Beyond the methodological interest of a research in a hybrid context of spatialized physical interactions and remote interactions through electronic networks, this research project adds a problematic on the constitution of a cultural identity, of a collective body for a bodily communication (Martin-Juchat: 2020), both physical and digital, on a territory. An updated confrontation of Certeau's audacious conceptual propositions proves stimulating, for example those of the weak actor and the resistance of user publics.

Moreover, the contribution of phenomenology by its historical anteriority, in particular the phenomenology of perception (Merleau-Ponty: 1945), has allowed to favour the understanding of the processes at stake in our relationship to the analogical image. A contemporary rereading of its principles and more recent research (Gualeni: 2015) works to extend this contribution in questioning our relationship to the digital image and its remote access via networks. From a partial support on "a sociology on the digital" (Boullier: 2019) that does not consider that the researcher is not himself a producer of digital content, iconic and digital research works are planned to think a "continent populated by identities".

The aim is to extend my work on commutative communication (Ibanez Bueno: 2016) and on visual, sensory and interactive methodologies in the human and social sciences.

Among the scientific and artistic works partially close to our approach, Terra Forma by the researcher Frédérique Aït-Touati in association with Bruno Latour seems to us emblematic in its declension as a live show. In addition to the human, technical and logistical resources partners are able to work over time with a public of users in order to grasp the sensitive manifestations, in connection with the research questions and for its meaningful and aesthetic translation in the desired forms.

The different elements interwoven in a scientific and artistic whole dedicated to the electronic communication which has become omnipresent,

provisionally named the e-invention of everyday life, with visual, interactive and participative modalities for the final recipient public, are to be specified. A first scheme produced foresed the creation of a short film on De Certeau, a contemporary choreography based on a study of uses and interactions of the public via a reality qualified as augmented and the provision of glasses. Future exchanges and the ongoing writing of the project will allow the project to be correctly sized by associating other partners. Recourse to other partners may be justified, especially since the final device in the "spectacularized" version can be reproduced in other cities. At this stage, no details have been given of the other research outputs that could accompany this research, such as articles, books, exhibitions and conferences.

The research project has evolved since 2022. Thanks to the network developed by the UNITA alliance and to specific funding, the addition of artificial intelligence has become a necessity. I faithfully reproduce here the text of the proposal validated by the UNITA CHORAL program, in partnership with the University of Turin (Professor: Simone Natale).

At the time, the author was formulating concepts relating to the use of traditional media (books, print media, radio and television). Detour and resistance are examples of tactics developed by media consumers in the face of communication strategies.

The author, who died in 1986, was unaware of the mainstream Internet and more recent communication technologies such as artificial intelligence. The primary aim of this research is to question concepts applied to traditional media, and to revisit them in order to check their validity in the light of new developments in a now-hybrid daily life, i.e. both physical and digital.

The second objective is to experiment with visual and multimodal methods (Sarah Pink: 2011) in the service of research questions. The use of artificial intelligence is planned in aesthetic and computational terms, with a view to creating a Michel de Certeau avatar that will enable us to think about new theoretical propositions and interactive narratives specific to artificial intelligence, and to work on the public reception of this technology.

This perspective follows in the footsteps of Michel de Certeau, an interdisciplinary and creative author who broke new epistemological and methodological ground within the humanities and social sciences community.

The research proposes an overlay on artificial intelligence, both as a research object and a research method.

Following an invitation from the Mexican Benemerita Universidad Autonoma de Puebla for Jacques Ibanez Bueno to take part in a research visit in August 2023, a first interactive production including an AI-generated avatar was created. The provisional result was presented (J Ibanez Bueno ; Marleni Reyes Monreal ; Miguel Escalera) at the International Symposium AI Cultures - Turin, 24-25 October 2023.

The proposed research will lead to three major research contributions, which complement each other:

1) Revisiting an author, Michel de Certeau, who retains his modernity and relevance for research on our contemporary societies.
2) Interrogating artificial intelligence in a multidimensional way, in its aesthetics, its narrative and its cultural and social effects.
3) Introduce artificial intelligence to the visual and multimodal methods used in the human and social sciences.

Two of the four axes of the Call for Project CHORAL are involved in this research project.

Michel de Certeau was born in a mountainous region, Les Bauges, near his hometown of Chambéry. The development of Michel de Certeau is intangible heritage in terms of collective and individual memory and is in relation to priorities of Choral Program:

+ "Intangible cultural heritage and identity narratives: oral traditions, romance languages and literature, performing arts (music, dance, drama), rituals, travels, cultural identity, religion, collective and individual memory, migrations, vulnerable communities, gender studies, transnational history, values, human rights."
+ "Enhancement and dissemination of cultural and natural heritage: tourism and valorization, education, communication, heritage management, digitization/digital tools, storytelling, institutions and heritage".

A prototype for the creation of heritage content (live performance; interactive production for museums) via digital tools using artificial intelligence to enhance interactive storytelling.

LLSETI, my research group at University Savoie Mont-Blanc specializes in Images and Digital Arts for the design of interactive devices. It has also initiated an international network https://visualmodi.hypotheses.org with an international research association on visual and multimodal methods, whose president is mine.

Simone Natale's research team in Turin specializes in the social and cultural dimensions of new communication technologies, with a particular focus on artificial intelligence. He will contribute to supervision a specific expertise on current debates about the application of generative AI to cultural memory and cultural heritage, as well as insights into the cultural and social implications of applying generative AI, especially text-to-image and Large Language Models (LLMs), to the case examined.

In Pink's (2009) attempt to rethink ethnography due to the "sensory turn" in the humanities and social sciences, sensory ethnography is considered an alternative process for the creation of scientific knowledge with the participation of non-researchers. Within this "sub-discipline", participation goes beyond the principle of observation in the tradition of the anthropologist Malinowski, through the sharing of activities and the invitation to new forms of expression (Pink: 2009). The methodological sensory perception. The success of such a research protocol is strengthened if it serves the participants, beyond the sole research intended by the researchers. This is the case of action research or research-creation (Chapman; Sawchuk: 2012) via a social aesthetic (McDougall: 2006; Pink: 2009) which, through artistic expression, can contribute to an individual and collective expression associated, for example, with an unfinished construction of identity and social claims in the process of formalization (Boal: 1977; Dubuffet: 2019). The artistic activity is not considered as a visualization or a scripting of scientific results of research produced upstream, but as a new experience for individuals generating elements to be converted into data, thanks to a language qualified as multimodal and not only verbal. innovation with new forms of participation uses.

The quest for a "phenomenological reality" (Mac Dougall: 2006) is an important component of the development of evolving and questioning methodologies. Participants are expected to have a phenomenological experience. The term phenomenological in its polysemic limits is taken here at two levels: within a more conceptual phenomenology of European tradition and a phenomenology with a methodological and more applied dimension (Van Manen: 2002), relying on the Husserlian origin of the "return to the things themselves" of the great scientific project for the audacious elaboration of a new science. This second methodological orientation is more noticeable on the American continent, which authors call post-phenomenology (Ihde: 2001) "a modern, updated, Americanized version of European phenomenology" (Puech: 2007).

CONTENTS	UPSTREAM APPROACH	SCIENCE SHOW Linear or intersecting parts	PARTNER ASSOCIATE	UNICITY	A DOWNSTREAM VERSION OF THE SCIENCE SHOW
Portrait of Michel de Certeau and his work	Textual and iconic documentary research Audiovisual and interactive design	On-screen broadcasting Linear film (or interactive film in its non-science-show version)	LLSETI historians of religion and Savoy Designer video (institution?)	Yes	Online and/or on DVD book object
Assumptions His thoughts on de-tour. (Theme: RSN bodies between social communication and surveillance). Non-Foucauldian Internalize screen interaction and experience.	Collaborative, sensory, visual and phenomenological methodology image recording (visual and sensory anthropology): oral, bodily and danced expression with image and sound recording. Contemporary dance by non-professional members of a social group Boal and DubuXet-type approach (Grand Mothers. Los Espontaneos; Jobin)	Dance contemporary	Scène Nationale Malraux Chambéry (France) Auditorium Tenerife (Spain) ? Marseille?	No	Online and/or on DVD book object
Phenomenological concepts of telepresence (Filiation of Weissberg; Amato)	Contemporary choreography based on concepts, either verbatim from participating subjects, or mixed) Correspondence through extensions of images from the digital world through extensions in augmented or mixed reality with glasses Professionals (e.g. TSCHAGG)	Contemporary dance and Augmented reality or mixed with glasses	In Marseille: Norbert Elias Centre ?	No	Online and/or on DVD book object
Audience interaction		Public feedback: movements; opinions; portraits; etc.		No	Captured Online and/or on object book DVD Interactive webdoc extensions

Beyond the "practical turn" (Depraz: 2004) and "the intersubjective socialitý of experience," phenomenology in its potential to enrich methodological innovation contributes to interdisciplinary approaches such as combining anthropology and phenomenology: "phenomenological description: to describe is to understand a signifying totality" (Laplantine: 2005).

In the current of so-called participatory research methods, this triple influence facilitates methodological fertility through the intersection of visual methods, sensory ethnography and the phenomenological framework. It is important to note that the digitization of uses is superimposed on another digitization, that of visual methods which either maintain linear narrative forms (research video), or integrate computer interactivity such as virtual reality (VR) or augmented reality. In this field, at my initiative, a dossier on Digital Images and New Writing, co-ordinated by myself, on the latest methodological and digital developments has just been published in the Revue Française des Méthodes Visuelles (Ibanez Bueno; Marin: 2021). It adds to my active participation in the research group "Image, Transmedia Writing and Social Sciences" (GDR2049 - INSHS/CNRS - Section 38. Anthropology and comparative study of contemporary societies), since 2018 and to the steering committee of the two Salons des écritures alternatives en sciences sociales at the MUCEM in Marseille since 2020.

This methodological foundation through the construction of an innovative methodology adapted to the problematization, at once visual, digital, sensory and phenomenological, should at the end of the research result in research productions in moving images (video), choreography and augmented reality.

Michel de Certeau, an author who died in 1986 and is still influential in France and abroad, produced a prolific and diverse body of work that is still difficult to grasp today in its complex globality (Maigret: 2000). Fundamentally interdisciplinary and "an author, sometimes presumed to be fickle and inconstant", from the history of religions he associates history, sociology, anthropology, semiotics and psychoanalysis. Through his personal history as a Jesuit and his religious practice, he proposed questioning the scientific approach to the point of abusing the proponents of research on religion and the structuralist and Marxist currents of the time. He does not hesitate to deconstruct the posture of the researcher in a quest to question the certainties in the service of a scientificity within

the human and social sciences. From the concept of popular culture and its contradictions, he does not spare the researchers in their supposed ethnocentrism shared within the elites.

The media and information technologies are one of the major fields of his work that we find in his most accomplished publication: the invention of the everyday. Using his terminology, the uses are questioned as well as the arts of making, subtitle of the invention of the everyday. Mirroring Bourdieusian and especially Foucauldian thought, he proposes a way of thinking that does not totally take up the deterministic origins that would explain individual and collective behavior, the latter being the result of an alienation from structures such as the State, which would act in a totalitarian and vertical manner, from the top down. Users are not "supposed to be doomed to passivity and discipline" (De Certeau, 1990,).

The effective reception of the mediatized messages does not correspond to the conveyed contents and the users by this reception in shift produce new messages. The "weak" resist, transform and divert by a "polemology of the weak" (De Certeau: 1990) thanks to their creativity. The author joins American functionalists (Lazarfeld: Paul Lazarsfeld; Berelson; Gaudet: 1944) who question the "telegraphic" model and the supposed omnipotence of the media on the behaviors and the opinions of the recipients. The users are thus "poachers" who reinterpret with pleasure the meanings conveyed by "shots", true aesthetic acts of resistance. A great qualitative and international research on the globalized television series as for the numbers of samples of televiewers gives him reason later (Katz; Liebes: 1993). The concepts of nomadism and appropriation become fundamental in the Certalien work on the uses (paper publications; radio; television).

The thesis of social change runs through De Certeau's work and revisiting his work after the Digital Turn in a questioning of the social and cultural appropriation of the latest communication technologies and digital communication networks (which the author did not experience) constitutes a stimulating site for the social sciences. His caution regarding theoretical frameworks and the formulation of any new theoretical framework remains formative for current research in an approach that is not mono-disciplinary. In keeping with his taste for empirical and qualitative research, the aim here is to mobilize our work on methodological innovation presented above for a contemporary application to the field of social communication characterized

by the generalization of digitalization (cell phones; social networks) in human interactions, through the revisited Certalian prism.

To conclude, I propose to work together to answer the following questions. How can we transform an intellectual figure born in a mountain region into a tourist, heritage and civic opportunity? What kind of digital appropriation should be proposed? How can we articulate a contemporary, applied research project that applies the author's concepts to today's world?

References

Bergold, Jarg, Stefan Thomas, «Participatory Research Methods: A Methodological Approach in Motion [110 paragraphs]», Forum Qualitative Sozialforschung / Forum: Qualitative Social Research, [Online], 13, no 1 (janvier 2012): paragraph 5-9.

Boal Augusto, Théâtre de l'opprimé, Paris, Ed. La Découverte Poches, 1996.

Chapman, Owen, Sawchuk Kim (2012), « Research-Creation: Intervention, Analysis and "Family Resemblances" », Canadian Journal of Communication, vol. 37, n°1, 2012, 5 26.

De Certeau, Michel, L'Invention du quotidien, 1. Arts de faire, éd. établie et présentée par Luce Giard, Gallimard, Paris, 1990, (1re éd. 1980)

Boullier, Dominique, Sociologie du Numérique, Paris, Armand Colin, 2019

Depraz, Natalie, « Le tournant pratique de la phénoménologie », Revue philosophique, n°2 / 2004, p. 165

« Jean Dubuffet, Un barbare en Europe », Exposition, MuCEM, Marseille, 24 avril-2 septembre 2019

Gualeni, Stefano, Virtual worlds as philosophical tools: how to philosophize with a digital hammer, Palgrave Macmillan, New York, 2015

Ibanez Bueno, Jacques, Le corps commutatif : de la télévision à la vidéophonie, Collection écriture et représentation, LLSETI Editions, Chambéry, 2016, 191p

Ibanez Bueno, Jacques, Marín, Alba, Dossier coordonné par, « Images interactives et nouvelles écritures », Revue française des méthodes visuelles, [En ligne], 5 | 2021, mis en ligne le 9 juin 2021, URL : https://rfmv.fr, ISBN : 978-2-85892-471-4

Katz, Elihu, Liebes, Tamar, « Six interprétations de la série « Dallas » », Hermès 11-12, 1993, p. 125-143.

Laplantine, François, La description ethnographique, Armand Colin, 2005

Martin-Juchat, Fabienne, L'aventure du corps, Presses Universitaires de Grenoble, 2020

Merleau-Ponty, Maurice, Phénoménologie de la perception ,Gallimard, Paris, 1945

Lazarsfeld, Paul, Berelson, Bernard, Gaudet, Hazel, The people's choice: How the voter makes up his mind in a presidential campaign. New York: Duell, Sloan, and Pearce, vii, 1944, 178

McDougall, David, The corporeal image Film, ethnography, and the senses, Princeton University Press, New Jersey, 2006

Mauss, Marcel, « Les techniques du corps » in Journal de Psychologie, XXXII, ne, 3-4, 15 mars - 15 avril 1936

Mead, Margaret. « Visual Anthropology in a Discipline of Words (1974) ». In Principles of Visual Anthropology (Edited by Paul Hockings), 2e éd., 3-13. Berlin / New York: Mouton de Gruyter, 1995.

Van Manen, Max, Writing in the Dark : Phenomenological Studies in Interpretive Inquiry, Althouse Press, Western Ontario, 2002

***About the Author:**

Jacques Ibanez Bueno: Assistant in Switzerland at the Faculty of Psychology and Educational Sciences of the University of Geneva, is preparing his PhD in Information and Communication Sciences at the University of Grenoble, France, on the synergies between television and the recording industry.

A contract researcher at the GRESEC laboratory, he works on research contracts for private and public players. As a lecturer at the University of Burgundy, he took part in the creation of new training courses, in particular an institute in Enterprise Documentation, Networks and Image Engineering, as project leader and first director. He contributed to the creation of a new research team, LIMSI (Laboratory on Image, Mediation and International Communication). From 2003 onwards, as a lecturer and then professor at the Université Savoie Mont-Blanc, he was responsible for the creation of a complete interdisciplinary degree program (Bachelor Master Phd), being the first director of a Hypermedia and Communication Department and the first head of a research team (G-SICA Inter-

Laboratory Group on Image, Communication and Digital Arts) before joining the LLSETI Research Group. He is a regular guest at European and American universities.

In 2010-11 at the University of North Texas, he developed research with USA colleagues on the appropriation of emerging uses of iconic technologies (using Visual Methods). In 2016, he published a book entitled "the commutative body: from television to videophony".

In 2022, he was awarded a one-year CNRS delegation to carry out research in Marseille at La Fabrique des Écritures Ethnographiques within the Centre Norbert Élias laboratory. This research, which is being carried out in four countries (Switzerland, Mexico, Spain and France), examines digital worlds through a re-reading of Michel de Certeau's work. As the centenary of de Certeau's birth approaches (2025), he is spearheading the creation of an international network in support of this commemoration.

In 2022, he became the first President of the learned society VISUAL MODI (International Association for Research in Visual and Multimodal Methods): https://visualmodi.hypotheses.org

PART II. Discussion topics in the Cultural Heritage round-table

Moderator: Helena Alves

Round-table members: Giovanna Hendel, Giulia Ferdeghini, Otilia Hedesan, Dana Percec,Renata Ferraz

3.5. Notes from the round-table moderator

Helena Alves*

University of Beira Interior, NECE - Research Centre for Business Sciences

Research on cultural heritage in rural and mountain areas plays a crucial role in preserving the rich history and traditions of these regions, while also offering valuable insights into the complexities of human societies and environmental interactions. Research on cultural heritage in these areas helps document and preserve the unique identities, ensuring that they are not lost to modernization and urbanization. At the same time it helps to safeguard intangible practices, which are often at risk of disappearing due to changing social dynamics and economic pressures.

On another perspective, research on cultural heritage can enhance the opportunities to develop tourism products, since it valorises the endogenous resources and in this sense to boost economic opportunities for residents

Research on cultural heritage in rural and mountain areas is essential for preserving the unique identities, traditions, and environmental practices of these regions. By valuing and safeguarding cultural heritage, we not only honor the past but also create a more sustainable and enriched future for generations to come.

Researchers in the field of cultural heritage face a variety of challenges in today's world. One significant challenge is the preservation of cultural artifacts and sites in the face of factors like climate change, pollution, de-

velopment, and armed conflict. Ensuring the protection and conservation of these treasures for future generations requires both resources and interdisciplinary collaboration.

With this rationale guiding the Re-UNITA workshop on cultural heritage that took place at UBI on the 18th and 19th of April 2024, researchers from all UNITA partners gathered to discuss and exchange ideas and research that could aid the mountain territories where the partners are located.

On the first day of the workshop, there were 5 presentations introducing colleagues to several projects under development in each university and seeking partners:

- Ana Martins-Nepomuceno (UBI) discussed her project on cultural Heritage: Resilience of built heritage and built environment.
- Dénes Harai (UPPA) presented various projects related to written Heritage and archives, along with the research lines of his Research Unit (art of dry-stone walling, knowledge and techniques, tangible cultural heritage as a development factor in mountain areas).
- Jacques Ibanez Bueno (USMB) presented ongoing research on communication and digitalization.
- Gulia presented research on ethnomusicology and ethnomusical resources and systems of archives codification.
- Dana and Otilia (UVT) shared their project on food heritage.

The presentations highlighted connections between the projects, leading to the afternoon session focusing on finding common links between the projects and fostering collaboration.

During the workshop, the group dedicated time to discussing various topics of interest:

- Sharing experiences of collaborations, such as BIP and summer schools.
- Improving communication within the group and with potential new colleagues interested in joining.
- Enhancing collaboration within the group.
- Exploring activities to engage society more with this HUB.

The challenges posed by the digitalization of cultural heritage were also addressed. While digital technologies offer enhanced access to and understanding of cultural artifacts, they also raise concerns about data pri-

vacy, digital preservation, and the impact of virtual experiences on physical sites and objects.

Despite these challenges, researchers in UNITA cultural heritage HUB continue to develop efforts and research to understand the past and its importance in the present. By approaching these obstacles with creativity, collaboration, and a commitment to ethical practice, they play a pivotal role in safeguarding and celebrating human cultural diversity.



***About the Author:**

Helena Alves is Full Professor of marketing at the Business and Economics Department and researcher at NECE, University of Beira Interior, Portugal. Her areas of expertise include Customer Satisfaction, Services marketing, Tourism marketing and public and nonprofit marketing having authored and co-authored several articles and book chapters on these themes. She was the editor of the International Review on Public and Nonprofit Marketing until 2024 and is also part of the editorial review boards of several journals. Coordinates several projects, namely the Enter-EdTech project (at national level) - Entering the EdTech Entrepreneurship World and The U-Value project – The impact of Higher Education Institutions on the Quality of Life of the Regions. Currently, she is the Vice-Rector for Teaching, Academic Affairs and Employability.

3.6. Some past Cultural Heritage Hub successful projects and some more to come

Giovanna Hendel*
Cultural Heritage Hub Coordinator
University of Turin

As Cultural Heritage Hub Coordinator, I participated to the discussion session of the workshops, first of all by focusing on some examples of activities of the Cultural Heritage Hub which were particularly successful. These were the CH summer/winter schools belonging to the 'RandoPat/ HeriTrail' (Randonnées du Patrimoine / Heritage Trails) series:

Randopat 1: 'Mushrooms, Herbs and Raw Food : Practices and Beliefs', Universitatea de Vest din Timişoara, 7-11 November 2022

Randopat 2: 'Sur les Chemins de Roland', UPPA, 12-16 June 2023

Summer/winter schools are not only pedagogic activities. The group of students and teaching and research staff who share this experience, having numerous discussions together, walking together in an Aristotelian peripatetic spirit, become a community lasting beyond the summer/winter school in question. And, in particular, during these discussions the seeds are sown for future research partnerships. Researchers need face-to-face opportunities like these, of in-depth discussions throughout several days, in order to develop long-lasting research partnerships, and to associate students in their making is part of the vision of a modern European university in which the future generation of researchers is actively involved in the dynamics of research right from the early stages of their training.

I then provided three examples of research projects, which were still open to new colleagues joining the research team. And the research team of the first of this project could not, indeed, have come about without the encounters made at another CH summer/winter school:

'Cultural heritage and depopulated areas : case studies and rural development', UNIZAR (Jaca), 2-6 October 2023

1. 'Conflicts of Memory, Memories of Conflicts: An Interdisciplinary Approach to Cultural Heritage Conservation, Development, Valorisation and Re-attribution of Meaning(s).'

Principal Investigator: Daniele Pipitone (UniTo); Research Team: UBI, UNIBS, UNIZAR, UPPA, UVT, CHNU.

European societies have all experienced, in recent or distant past, violent internal conflicts, as well as international ones. Such conflicts have left deep marks in their cultural heritage, that in turn have fostered harsh conflicts of memories. The memory of the fascist and communist dictatorship, the world wars and the civil wars within them, the ethnic cleansings and the postcolonial heritage are but the most famous examples of the complex and often contradictory relationship that links present societies with their "lieux de mémoires" (NORA, Between Memory and history… 1989). The concept of "dissonant heritage" (TUNBRIDGE, ASHWORTH, Dissonant Heritage… 1996) has been introduced to describe such tension between a society and the traces of its past. It refers to places, monuments, buildings, but also audiovisual archives etc., that are reminders of an uncomfortable and hard-to-accept legacy, for example of dictatorships such as Nazism and Fascism, or of colonialism.

Social sciences and humanities have long since addressed such entangled relations, from many different perspectives: sociology, philosophy, history, cultural studies, heritage conservation studies. Despite the relevance of these studies, however, they have mainly focused on a national scale, neglecting or underestimating the transnational dimension of cultural products and narratives – a transnational dimension that is in fact essential to fully understand the recent past and the present itself.

The project aims to overcome such nation-centred perspective and to adopt a more balanced one. Thus, not only will it be based on the cooperation of scholars from different disciplines and countries across Europe, thus fostering a comparative and interdisciplinary approach. It will also focus on the transnational communication of cultural products and narratives and on the many ways this circulation affected and influenced the interpretation and the fruition of the national, or even local, cultural heritage.

2. RESPYR

Principal Investigator: Laurence Roussillon-Constanty (UPPA); Research Team: UNITBV, UniTo, UNIZAR, USMB, UVT.

The "RESPYR" project aims to study the mountain landscape by crossing several approaches and several views and by proposing a dialogue between specialists of different eras and disciplines. The starting point of the project is anchored in the nineteenth century and focuses on the study of accounts, poems and drawings by British travellers in the Pyrenees and on the representation of the mountains by major writers of the time, such as John Ruskin. It also includes a translation of the travellers' writings (English/French).

Its originality lies in the way it combines hands-on approaches to research – through translation seminars for Master students and field-trip to connect today's landscapes with historical archives – and digital dissemination through the use of the academic platform, Cove (https://studio.covecollective.org/).

Initially based on a Franco-British collaboration (with Manchester Metropolitan University), the project also aims to develop on a European scale thanks to projects with the University of Savoie Mont Blanc in Chambéry, and by starting collaboration with universities in the UNITA consortium. It has received funding from the UPPA (AAP incitative research scheme, 2021, 2023 Innovative pedagogical initiative Grant).

The scientific challenge of this project is twofold: to carry out research on a very local scale on the British presence in the Pyrenees and to participate in larger-scale projects on the representations of the mountain landscape on a European scale in order to participate in the development of landscape studies in the field of Anglophone studies.

3. GynoCult(r)ural

Principal Investigator: Christelle Colin (UPPA); Research Team: UBI, UniTo, UNIZAR.

The GynoCult(r)ural project aims to list and map artistic and cultural works or initiatives from the recent past or present, imagined and produced by women in rural and piedmont areas. The aim is also to carry out a comparative and transdisciplinary analysis of these productions, to define the role of women in the development of culture in specific rural territories.



***About the Author:**

Dr. Giovanna E. Hendel has been working as Cultural Heritage Hub Coordinator for UNITA since September 2021. She has previously occupied roles of Coordinator of Cultural Heritage projects, working for international organisations and institutions such as UNESCO, the Bibliothèque nationale de France, the Musée national de la Renaissance, and the Wallace Collection, London. Her specialism, as a scholar, are 16th century book and art collections and digital heritage collections (cf. Les livres d'heures imprimés de la collection du Musée national de la Renaissance, Réunion des musées nationaux, 2017). However, she has also published within multidisciplinary teams of researchers on projects conceived on her different posts (e.g. They Did Not Stop at Eboli: UNESCO and the Campaign against Illiteracy in a Reportage by David "Chim" Seymour and Texts by Carlo Levi (1950), G. Hendel, C. Naggar, K. Priem (eds.), UNESCO-De Gruyter, 2019.)

3.7. Encouraging participation through actions that support students' training and academic career

Giulia Ferdeghini*
University of Turin – Department of Humanities

During the Workshop/round table on Cultural Heritage held on the occasion of the Re-Unita Workshops "Research Challenges for Cultural Heritage, Circular Economy and Renewable Energies in Rural and Mountain Areas", urged by the Cultural Heritage Hub Coordinator Giovanna Hendel, and shared by all participants, the issue of disseminating communications concerning Unita's activities within the universities involved rose powerfully: notably the difficulty of gathering participants, involving students and researchers in mobility activities, and also in the online organized projects such as Weekly-Talks.

Even though one of the project's main objectives is "to foster student mobility as a vehicle for international and intercultural education within the European Higher Education Area"[17], this ambitious idea seems not to have taken off so far. The scarce involvement is because a lack of circulation of information about not only the events but also the funding opportunities, or to the hurdle of tracing common interest topics for all the units involved. An unthorough knowledge of the organization and functioning of the consortium and the branches into which the project is divided was detected among non-active Unita's members. This is certainly not due to a lack of commitment by those in charge, but rather to a tangible impossibility in reaching researchers and students not directly involved in Unita's projects and encouraging them to participate in the activities and events proposed and regularly organized with considerable effort by the various units.

This might be due to several factors, the first being logistical, as mentioned above: the distribution of information and circulation within the

[17] Cfr. < https://www.unito.it/internazionalita/unita-universitas-montium >

various universities does not work optimally and the news does effectively reach a small number of people. Some alleged that this is because the excessive centralization of both communication and organizational mechanisms: the Unita Offices in charge, which have to cope with intense administration and management, cannot also cope with the communication and publicity needs of the consortium to increase participation. This results in Offices disseminating information only through official channels, which presumably do not receive focused and priority attention from the selected public. As a result, they are ineffective in encouraging more active involvement in Unita actions. Bureaucratic tasks absorb a lot of energy and working time, while instead, those necessary for information, publicity, and involvement seem to suffer. The lack of information/communication results in the lack of knowledge of the topics covered by the individual projects in each university.

Another issue, imposed by the need to integrate all research areas belonging to the Cultural Heritage HUB, is likely to be the overly broad definition of thematic areas for the activities e.g. by the Randopats or the Winter Schools or the BIPs. The HUB of Cultural Heritage is extremely diverse and perhaps excessively broad in terms of the types of coexisting disciplines, research methodologies, and themes. This variety, which certainly can offer a wide range of ideas for interdisciplinary project building, is nevertheless disorienting due to the diversity of the various disciplines research areas, project focuses, methodologies, and practices. Finding common research questions or themes for workshops and "Thematic schools" involving all disciplinary areas is very complex, and without an underlying project line, it may not seem attractive.

However, during the presentations of the projects, common themes emerged among research fields and disciplines involved, whose topics range from architecture and landscape revaluation to industrial archaeology and 'industrial heritage', local history, food ethnography, communication sciences, and media studies, artificial intelligence, ethnomusicological sound archives, digital humanities, studies on traditional practices and preservation of natural heritage, and so forth. Finding common interests among projects could provide opportunities for building collaborative research and fostering synergetic and interdisciplinary work.

This shortage of participation risks turning into a missed opportunity for (scientific, methodological, and even human) growth, whereas many of

the themes and (work)fields of research are common, and it would therefore be useful and productive to discuss the possible convergence of scientific interests, adopted methodologies and the needed tools i.e to disseminate research products.

What I suggested concerned the need, shared by some, to trigger a decentralization process, to make both mechanisms and communication more flexible. It might prove useful to create one (or more) intermediary, organizer, coordinator, or scientific referent, who in each university, is responsible for grouping people to regularly, cooperatively, and actively participate in Unita activities, and also coordinate, for example, the communication of the research activities carried on by each university, transferring targeted information to those who are dealing with similar issues and/or have similar or integrable projects underway. The coordinator should therefore make the information on existing projects flow more widely and purposefully within the hiring HUB and thus act as a 'matchmaker' between researchers with common interests. This could promote greater collaboration between Unita's partner universities and help the construction of inter-university networks, for instance, useful in the large-scale, high-profile EU projects building.

Another proposal I put forward to achieve the goal of broader student participation is to direct as far as possible the activities for which student participation is required towards active and integrated didactics, i.e. by creating short paths within their course. This educational purpose could then easily work in opening to the general public, as someone suggested during the workshop, and thus extend the effectiveness of the cooperative effort to "Third Mission" actions and dissemination. Specifically, students could prepare short essays or lectures to be presented in dedicated conferences or integrated into the activities proposed by the host university. This prompt of active teaching and functional use of students' knowledge could also subsequently incentivize participation in PhD Cotutelles.

Another incentive would be the call for ISSN publications, which for researchers, PhD and also MA students, should be appealing to engage in shared projects or to participate in events at which they could exhibit their research work, contribute to collaborative projects, publish short essays or articles concerning their research.

In conclusion, since the main problems that emerged are the difficulty in creating interest or effectively communicating about Unita's activities

among students, and researchers in each of the disciplines belonging to the Cultural Heritage HUB, some solutions could be, on the one hand, to create a contact person who, in each university and for each of the HUBs, specifically manages communication of the consortium's ongoing research activities and projects and possibly acts as a link between researchers working on similar topics, keeping them mutually informed, through targeted and personal communication in addition to what has so far extensively been done.

In addition, calls for papers, conferences, panels, or other valid forms to implement the CVs of young researchers (especially PhD students) could rally participation.

***About the Author:**

Giulia Ferdeghini is a research fellow and ethnomusicologist at the Department of Humanities at the University of Turin. Her work focuses on Linked Open Data and knowledge representation systems in the field of ethnomusicology and silent film music. She also teaches Ethnomusicology for the DAMS degree course at the University of Turin. Her area of expertise is the musical culture of the Kurdish people, she a specialization in the sung epic in Iraqi Kurdistan. She has recently published a book titled Beyta Dimdim: storia, struttura e analisi di un canto epico curdo (Beyta Dimdim: history, structure, and analysis of a Kurdish sung epic, LEVI 2024). She participates in the activities of a research group sponsored by the Ugo and Olga Levi Foundation on Kurdish epic and narrative singing.

3.8. UNITA provides an opportunity for scholars to work together on cultural heritage

Otilia Hedeșan and Dana Percec *
West University of Timisoara

What challenges do you believe the researchers of cultural heritage face currently? In front of global changes, but also within UNITA and the regions were they are located?

We live in an ever-changing era, and the speed at which this is happening is increasing. This situation, disturbing for the entire world, is, at the same time, stimulating and extremely difficult and complicated for cultural heritage scholars.

In our opinion, working today in this field, there are two important issues that cannot be ignored. Firstly, the study of heritage focuses on its value over time, structuring it around topics such as stability, durability and sustainability. At the same time, we live nowadays in a period of permanent change, which also requires further documentation. We need to find the right methods to negotiate between the canonical themes of our research and this reality that cannot be ignored.

Secondly, cultural heritage has been an important part of the actual historical realities, of the socio-cultural and economic life of the communities. Today it is both augmented and challenged by an important virtual reality. This virtual world strongly exposes the various aspects of heritage, but sometimes it tends to disrupt the relations between heritage and on-site realities and to reduce citizens' involvement in heritage preservation.

Beyond these general challenges of the Cultural Heritage domain, the UNITA alliance brings together universities from countries with very different backgrounds. Of course, we are talking first about countries where the national languages spoken by most of the inhabitants are of Romance origin. Then, in some cases, there are neighboring countries

and even regions that have been in contact for centuries. But, at the same time, we are also talking about countries that know little about each other, and the recent contact – caused, for example, by the massive migration of Romanians for work in the last decades – was not necessarily a fortunate first encounter.

UNITA provides an opportunity for scholars from these spaces to work together on cultural heritage, discovering the differences between the cultures to which they belong but, we would like to think, and this is what I find most fascinating, as well as the amazing similarities (which need to be explained). What a fascinating field of study and, indeed, what a challenge!

How can we intersect the research in cultural heritage with climate change in the mountain areas of UNITA?

Human communities have always been confronted with a long series of dangers and challenges. Insecurity, wars, sickness, famine have marked their history, and cultural heritage as we know it today is, among other things, the result of responses to these provocations. As an anthropologist, I believe that we have something to learn from human communities that have found, for long periods of time, appropriate solutions to live even under difficult conditions. So I would say that first we need to find out as much as possible about what communities know about crises, including climate crises, and support them to engage in finding solutions. I also believe that it is extremely important to support communities if/when regional, national or international authorities offer consistent solutions for change that impact their lives.

How can we engage communities in the Cultural Heritage HUB research?

In recent years, working together with colleagues from several UNITA universities, I have learned about their experiences and I am now tempted to say that we could, already, open a best practices small repository in Cultural Heritage and relations with local, remote and rural communities.

For the purpose of this argument, we will mention here how the research group coordinated by Otilia Hedeșan at the West University of

[18] https://www.rhea-uvt.org/

Timișoara, RHeA (Research Centre for Heritage and Cultural Anthropology)[18], interacts with local communities from the cross-border region of Banat. Special relations are thus prioritized with a number of towns in the region where the university is located (between these: Kikinda, Uzdin, Șișești, Rudărie, Armeniș, Glimboca, Eșelni a etc.). These are villages or small towns with which the University (through RHeA) has joint research or development projects, implemented together with local authorities (and where experts from the University can organize research or provide scientific expertise for the benefit of the community). Complex research (sociological, geographical, ethnographic, etc.) representative of the region has also been carried out in these localities over time. Consequently, revisiting these places with students is both a research experience for the younger generation and an integration into a university tradition. These relations with local communities often involve schools, with which we develop different educational activities, including education on cultural heritage.

How can we foster Cultural Heritage research within UNITA?

In my opinion, UNITA has marked its interest in cultural heritage from the very beginning, in particular by defining a hub dedicated to this field of interest. UNITA also launched, at the very beginning of its operations, a Cartography[19] of the interests of researchers from universities represented in the alliance. These activities are very important because they expressed a prioritization of interests on cultural heritage and also facilitated the dissemination of the researchers' knowledge and their subjects of expertise.

I think it is mandatory that UNITA defines more precisely (and very professionally) what is meant by cultural heritage. Then, we think, UNITA needs to identify which university departments and research laboratories are working on these issues. Perhaps a collaboration with the education work packages would make things move faster. We believe that, on the basis of these analyses, UNITA can identify its strenghts and work on them with priority. For example, the heritage of remote, rural and cross-border regions can be one such element to customize research, defining an area of UNITA excellence.

_____
[19] https://www.uvt.ro/fr/unita/unitas-research-innovation-cartography/

***About the Authors:**



Otilia HEDEȘAN is a Romanian anthropologist, professor of Romanian Culture and Civilization at the West University of Timisoara. Since 2015, coordinator of the RHeA research Centre, as a space of inter- and multidisciplinary interaction of young scholars. (PhD or postdoctoral researchers). She carried out or / and she coordinated ethnological field research in Eastern European countries: Romania, Bulgaria, Croatia, Hungary, Moldova, Serbia and Ukraine. Her main areas of interest are: everyday life in multi-ethnic communities, folklore and popular mythology, storytelling and narrative genres, food heritage. She is equally interested in the history of Romanian ethnology in European context, in this framework, being preoccupied by the status of folklore archives in Romania (in particular those situated in the cross-border Banat region). She coordinates the Cultural Heritage hub at UVT in UNITA 2.



Dana PERCEC is professor of English literature at UVT. Her main areas of interest include early modern English theatre, Victorian fiction, cultural studies, gender studies. She is a member of several professional associations (Romanian Society for English and American Studies, European Society for the Study of English, European Shakespeare Research Association, the Romanian Writers Union). She has published books and articles in the areas of Shakespeare studies, contemporary British literature and culture, reader response theory. She has coordinated a series on genre theory at Cambridge Scholars Publishers. She is a member in the editorial team of several indexed scientific journals (British and American Studies, Brukenthalia). She coordinated the Cultural Heritage team at UVT in UNITA 1.

3.9. Re-UNITA Workshops: for an effective communication to and beyond the Cultural Heritage HUB

Renata Ferraz*
University of Beira Interior - LABCOM - Communication and Arts
and CIEBA – Multimedia (UL)

The Cultural Heritage round-table was focused on the topic of effective communication strategies for the HUB's actions. It became evident that many researchers are still unaware of the UNITA and its HUBs or its activities. This led to discussions about the best ways to communicate with and beyond the Cultural Heritage HUB.

I was somewhat of an outsider on that round-table. I am not specifically from the field of Cultural Heritage. Nevertheless, I engaged in a discourse about this HUB to the extent that I am an artist-filmmaker and researcher who prioritises transdisciplinarity. I am also the responsible researcher for the Laboratory of Research and Shared Creation, which encompasses projects that are carried out in the mountains and rural areas of Covilha and its surrounding region, and thus related to Cultural Heritage.

My own research is focused on the creation of films with marginalised women ranging from decentralised areas to urban and cultural centralized locations. At this stage, I have collaborated with women who sing and play traditional musical instruments. The women do not sing as a profession; rather, they sing to give strength to their resilient lives.

One of the biggest challenges is finding ways to not only record a memory, a landscape, a traditional festivity, and so on, but first of all to find ways to create with people, landscapes, and other living beings. The challenge is not merely to give voice to a tradition; it is also to find ways to be open to listening to the numerous voices that have been encountered in the course of this research, which has spanned a year and a half. Another challenge has been to understand how people from the community can have creative gestures by my side. This means that they are not an object

of my study but a subject of the discourse that changes my own practice, insofar as every research process requires a balance between resistance and resilience. Those two forces seem to be the pillars of Cultural Heritage in the face of global changes.

In this context, I would like to refer to two thinkers: Emmanuele Coccia, a European researcher who combines studies in philosophy, biology, and ecology, and Ailton Krenak, a Brazilian indigenous writer, philosopher, and environmentalist. Despite their different backgrounds, they address similar issues regarding climate change, which can help us consider the intersections between research in cultural heritage and climate change. They are interested in exploring the concept of a human being belonging to the Earth. Coccia develops the idea of metamorphosis, which posits that all people are not just descendants of their mothers and bloodlines but that the experience of a human body is linked to all human and non-human life on the planet. Coccia states that "every living being is a legion. Each one sews bodies and selves together like a tailor, like a body artist who never stops chiselling their appearance." (2020: 7) The author posits that the multiplicity generated by this sewing leads us to consider that the history of species is linked to the idea of metamorphosis rather than evolution or progress.

Furthermore, the worldviews of different indigenous ethnic groups, as outlined by Krenak (2023), posit that humans are part of nature, akin to trees, rivers, and so on. Moreover, these non-human elements are perceived to have an active attitude towards humans. According to this perspective, the historical moment has arrived when nature is expelling us from planet Earth, and this can be observed in climate change. In this context, native people — and here we can also consider the knowledge of rural and mountain inhabitants — possess the necessary knowledge to resist these changes, as they are able to sustainably connect with the natural elements.

In this context, it seems plausible to suggest that the knowledge of those who have resisted the transformations of a so-called modern civilisation for centuries could serve as a valuable source of guidance for developing a fundamental understanding of the challenges posed by climate change. However, this raises a number of questions that remain unanswered: How can we reconcile the need for guidance from civil society with the necessity for scientific rigour? How can we propose a dual-track science that reaches out to civil society, but also modifies itself on the basis of its knowledge? How can we facilitate the integration of traditional

knowledge from rural areas and the mountains into the discourse of the younger generation?

Sustainability is a process that involves collective thinking and action. This brings us back to the challenge of effective communication. One of the primary objectives of the Laboratory of Research and Shared Creation, which I have been coordinating, is to engage communities in the Cultural Heritage HUB research. This entails devising a collective creative approach that is as significant as the individual artist's contribution.

Over the past few months, we have adopted a novel perspective: how can we integrate our research with community knowledge?

At the Laboratory for Research and Shared Creation, we are preparing to leave the university building and identify ways to engage with the community. Our initiatives will be focused on working within the community in the mountains, in rural areas, with other living beings, and within the landscapes of the Serra da Estrela. Our approach is not merely to visit these communities, but rather to be with them. We aim to foster a closer relationship with this world and facilitate a similar level of closeness between our communities. This requires time, which, in the current context, is increasingly scarce. In the context of history, the delivery of results must be expedite. The completion of work over an extended period of time can also be viewed as a form of resistance, while Intangible Cultural Heritage provides a compelling illustration of the importance of resistance and resilience.

References:

Coccia, Emanuele (2020). Metamorfoses. Rio de Janeiro: Dantes.

Krenak, Ailton (2023). Conversa na Rede: Amar, comer e ser comida - Ailton Krenak e Emanuele Coccia. Dispnível em: https://www.youtube.com/watch?v=5Dd5aosNQPU&ab_channel=SELVAGEMciclodeestudossobreavida



*About the Author:

Renata Ferraz has a PhD in Performative Arts and Moving Image at University of Lisbon. She is a research fellow at Labcom – Comunication and Art (UBI, Portugal). Also, she is a researcher at CIEBA, University of Lisbon. Renata is a film director and the responsible researcher of the Laboratory for Research

and Shared Creation (Labcom-Comunication and Arts). Her essays have appeared in scientific peer-reviewed journals, volumes, and cinema magazines. Her research interests include arts research, audiovisual narratives and creative processes in cinema and multimedia. Her latest film, Rua dos Anjos, has been shown in numerous international festivals, receiving awards that highlight the experimental research nature of her creations.

4. From the CIRCULAR ECONOMY Workshop

PART I. Research Projects in Circular Economy

4.1. SCARF Project - Design of Sustainable, CreAtive and Resilient Fibersheds

Ana Margarida Ferreira*
University of Beira Interior - LABCOM – Communication and Arts, and DESSIDE Lab

The creative economy encompasses two intertwined subgroups namely the culture economy and creative industries. Creative industries (Film, TV, Music, Digital media/ games/AI, fashion, design, and architecture) mostly build on the culture economy (including the traditional cultural sector, Patrimony, Heritage, Crafts, and Cultural practices). As outlined by the UNCTAD (United Nations Conference on Trade and Development) bi-annual Creative Economy Outlook reports, the global market for creative goods has expanded substantially, driving exports and creative jobs in creative economies. According to UNCTAD Creative Economy Outlook reports (2018, 2022), the global market for creative goods has expanded substantially more than doubling in size from $208 billion in 2002 to US $509 billion in 2015. China is the leader in creative goods export with a staggering 168 Billion US$ figure in 2015. Portugal and European countries have significant creative economy potential but also face various challenges in some fields such as labour force, market demand, infrastructure, data and conceptualization, support mechanisms and international trade. Labour force qualifications and job descriptions to fulfil creative industries sector occupations are not fully defined, and creative class potential is underexplored. The sector actors need access to data with international comparability in creative sectors. Studies for creative industries that investigate consumer preferences in-depth and an inventory of institutions and individuals operating in creative

sectors are still lacking. There is still space for research, innovation and education in the creative economy and creative industries, in the textile sector and *Design for Good Movements*.

The SCARF project, supported by the *Fibershed concept*, will explore this gap, co-designing more sustainable, inclusive, resilient, nature-based practice ecosystems with less environmental impact and digitally supported monitoring and evaluation systems rooted in circular economy ideas and practices.

To achieve the SCARF project objectives and goals, the following activities will be carried out:

- To map and characterize culturally, socially, economically and environmentally 5 European pilot fibersheds, reinforcing the concept and its sustainable dimensions at a local, regional, national and European level;
- To optimize fibersheds economic circularity while reducing its environmental pressure and amplifying its social dimension;
- To reinforce the digital literacy of fibersheds communities through co-creating digital platforms from a glocal perspective ("Think globally and act locally").
- To explore the potential growth path of the creative economy in fibersheds (case studies enrolment in this research project).
- To increase the creative economy engagement of the European fibersheds and its local institutions (all value-chain)
- To make awareness and highlight cultural creative and digital literacy to the creation of innovative products, services and systems, and;
- To reinforce the local networks to more resilient, wealthy and happy communities of practice.

The SCARF Project will be developed through inter, multi, transdisciplinary, and human-centred approaches, considering the complexity and systemic characterization of the fibersheds in a rural mountain area, its multiple players, and the envisioned goals of the SCARF project. Moreover, the project practices and outputs will be developed considering open science principles, ensuring the maximum dissemination and use of the project results through the fibershed communities and society at a regional, national and international level, supported digitally.



***About the Author:**

Dr. Ana Margarida Ferreira is an Industrial Designer, Assistant Professor with a Habilitation in Design at Universidade da Beira Interior (UBI), Senior Researcher at LabCom/iA*, and Coordinator of DESSIDE Research Lab and the Doctoral Course in Design.

She regularly collaborates with national and international Higher Education Institutions and Research Labs. She lectures (ed) Research Methodology, Applied Research, Industrial Design, Creativity and Innovation, Social Innovation, Circular Economy and Sustainability courses.

Dr. Ferreira successfully supervised 9 PhD Theses in Design and more than 28 master's research works, collaborating with companies, industry and other Portuguese and foreign Higher Education Institutions. She also coordinates several R&D+I projects.

Her leadership roles in academic and professional organizations reflect her influence and impact in the field. As the co-editor of DISCERN – the International Design Journal for Social Change, Sustainable Innovation and Entrepreneurship, and the founder and President of Creative Nature Hub, a Portuguese NGO, Dr. Ferreira is committed to driving positive change and fostering innovation.

She supervises postdoc, doctoral and master's students and participates in inter and transdisciplinary projects linking areas like Art, Design and Crafts, Engineering, Technology, Health, and Tourism. She regularly publishes in these areas.

PART II. DISCUSSION TOPICS IN CIRCULAR ECONOMY ROUND-TABLE

Moderator: Ana Paula Duarte

Round-table members: Sandra Ferreira, António Albuquerque, Tânia Lima, Karine Ricaud, Ion Imbrescu, Nicoleta Sîrghi

4.2. Statistical Contributions to Circular Economy: Analysis, Modeling, and Evaluation for Sustainable Practices

Sandra Ferreira*

University of Beira Interior - Mathematics Department and Center of Mathematics and Applications of University of Beira Interior

In our meeting, we discussed how statisticians can contribute to circular economy projects in various ways:

Statisticians can analyze complex datasets related to resource consumption, waste generation, recycling rates, and environmental impacts using techniques like regression analysis, time series analysis, and spatial analysis.

They can develop mathematical models to simulate and optimize circular economy systems, allowing stakeholders to evaluate different scenarios and optimize resource allocation.

Statisticians can be involved in conducting life cycle assessments to quantify the environmental impacts of products, processes, and services, calculating indicators like carbon footprint and ecological footprint.

By conducting probabilistic risk assessments and sensitivity analyses, statisticians can help decision-makers understand the likelihood and potential consequences of different scenarios.

They can also perform cost-benefit analyses to assess the economic viability and societal benefits of circular economy projects and investments, quantifying the associated costs and benefits.

Statisticians play a key role in monitoring and evaluating the performance of circular economy initiatives and policies, developing indicators, and tracking progress over time.

By effectively communicating complex statistical concepts and findings to diverse stakeholders, statisticians can build consensus and foster collaboration toward achieving circular economy objectives.



***About the Author:**

Sandra Ferreira is an Assistant professor in the Mathematics Department and Researcher at the Center of Mathematics and Applications at the University of Beira Interior. Research Group: Physics and Mathematical Modeling Group. Funding of Strategic Projects with Public Interest Promoted by Associated Laboratories and RD Units. UIDP/MAT/00212/2020
http://wordpress.ubi.pt/cma/physics-and-mathematical-modeling-group/
She is also an External Collaborator at the Center for Mathematics and Applications (CMA), NOVA School of Science and Technology | FCT NOVA. Research Group: Statistics and Risk Management. Funding of Strategic Projects with Public Interest Promoted by Associated Laboratories and RD Units. UIDB /00297/2020
ORCID: 0000-0002-9209-7772

4.3. Challenges for the Circular Economy and Environmental Protection in Rural and Mountain Regions

António Albuquerque*
University of Beira Interior - GeoBioTec@UBI, Department of Civil Engineering and Architecture

UNITA focuses on fostering research, experimentation, and innovation to benefit rural, mountainous, and cross-border areas. Promoting a circular economy and environmental protection in these regions can enhance local sustainability in the following areas:

- Sustainable tourism and infrastructure: Mountain regions, rich in ecosystem and tourism services, can advance by adopting sustainable practices. This includes constructing eco-friendly accommodations using local materials, implementing water reuse systems, and practicing organic waste composting. Additionally, promoting locally crafted artisan products and foods offers tourists and consumers unique, sustainable options.
- Renewable energy development: There are potential for several renewable energy sources (e.g., hydro, solar, biomass, microbial fuel cells, and wind power), which can aid communities in becoming energy self-sufficient and reducing carbon footprints. Small-scale hydropower, for example, is especially feasible in mountainous terrains with natural streams and rivers.
- Biodiversity conservation: Circular economy practices help conserve biodiversity by mitigating environmental degradation and promoting the sustainable use of natural resources. This could include sustainable forest management, water conservation, and protecting wildlife habitats from exploitation.
- Educational initiatives: Educating both residents and visitors on the circular economy's benefits and the broader importance of sustainability encourages behavioral changes. Training in sustainable

farming, waste reduction, and biodiversity benefits are pivotal in driving this change.

Through these strategies, UNITA can help to create resilient and sustainable communities that respect and thrive on their natural assets.



***About the Author:**

António Albuquerque is an Associate Professor in the Department of Civil Engineering and Architecture (DECA) at the University of Beira Interior (UBI), and a senior researcher at the GeoBioTec research unit (RU) at UBI. He has over 30 years of experience in the following areas: drinking water treatment and distribution; drainage, treatment, and reuse of wastewater and rainwater; integrated water management; and recovery of mineral and industrial waste. In the recent past, he served as the President of the College of Environmental Engineering of the Portuguese Order of Engineers, scientific coordinator of the FibEnTech RU, and Vice-President of the Portuguese Water Resources Association (APRH). He is currently President of DECA, scientific coordinator of the GeoBioTec@UBI RU, and Vice-President of the Portuguese Association of Sanitary and Environmental Engineering (APESB). His most recent technical and scientific work is associated with integrated water and waste management in low population density areas, using nature-based solutions and integrated into circular economy models.

4.4. Recycling and reuse of industrial waste

Tânia Lima*
University of Beira Interior - Center for Mechanical and Aerospace Science and Technologies (C-MAST)

Three studies were presented, all of them with the common aim of using waste from industrial processes to produce new materials and reintroducing them into the value chain through a circular economy approach. The processes used for recycling and production take into account the ability to scale up to an industrial scale and their cost. In the first two studies, the focus was on recycling thermoset-based polymer composites since due its characteristics and heterogeneity their recycling is a very challenging problem. In the first study a methodology for thermal recycling of glass fibre composites by combining different times and temperatures was tested. The static properties, tensile tests, and three-point bending tests were studied as well as the viscoelastic behaviour of the recycled fibres and respective laminates. For woven fibres, the most interesting results were the recycling process at 600 °C for 15 minutes, which revealed a loss of only 15.3% of the tensile strength. The laminates with fibres recycled at 400 °C for 180 minutes presented a reduction of 52.14% and 33.98% for tensile and flexural strength, respectively, representing the best solution. Some of the resulting materials, presented good mechanical properties and can, for example, be embedded in non-structural parts of cars as a way of reducing the material consumption associated with the automotive industry but also to answer the European Directive 2000/53/CE that defines 80% as the minimum amount of recycled materials in cars. The aim of second study was to define and test a methodology for recycling the waste resulting from their production of wind turbine rotor blades. Particles of waste from the mechanical machining of rotor blades provided by the manufacturer, which were made up of a glass fibre/epoxy matrix mixture, were used to produce toe caps for use by the

footwear industry. Characterisation of the laminates revealed that in the three-point bending tests, the additive laminates showed improvements of 18.60% in tension, 7.50% in stiffness, and 10% in deformation compared to the control laminate. The compression test showed that the additive glass fibre toe cap had greater resistance to compression than the control glass fibre toe cap, with a reduction in deformation of 23.10%. The toe caps are suitable for use in protective footwear according to European standard EN ISO 20346:2022. They guaranteed protection against low-velocity impacts at an energy level of at least 100 J and against compression when tested at a compression load of at least 10 kN. The last study is still under development and is being developed in partnership with a company that produces point of sale solutions. The aim is to develop a new sustainable composite material that allows the application of industrial wood waste for the production of supermarket displays. The research developed within the project should be aligned with United Nations Sustainable Development Goals (SDG). For instance, this three studies are aligned with objectives 9 (Industry, Innovation and Infrastructure) and 12 (Responsible Consumption and Production). This alignment of all UNITA and RE-UNITA projects with the SGD would be a way of affirming the relevance of the work performed within the framework of the alliance.



***About the Author:**

Tânia M. Lima obtained her PhD in Industrial Engineering and Management at the University of Beira Interior (UBI), in 2013. She worked from 2001 to 2010 in a civil construction and public works company in which she performed technical functions in the Department of Studies and Projects. She was an Auditor of the company's quality management system and was responsible for the safety and health at work in public and private works contracts. She is currently an invited Assistant Professor in the Department of Electromechanical Engineering of UBI, Coordinator of the degree in Industrial Engineering and Management and integrated member of Center for Mechanical and Aerospace Science and Technologies

(C-MAST) Research Group. She is involved in several research projects and in the supervision of master dissertations and doctoral thesis. Also, she is an author or co-author of articles published in several international journals and congresses proceedings. [ORCID: 0000-0002-7540-3854]

4.5. Comments on the Circular Economy round-table

Karine BRUGIRARD RICAUD*
University of Pau and Pays de l'Adour - UPPA Nutrition Metabolism and Aquaculture (NuMeA)
UPPA Circular Economy and Environment Hub referent (Re-Unita2)

First of all, we went round the table to introduce ourselves and describe our interest in attending and what we wanted to talk about. The various presentations covered very different approaches, which made them all the more interesting.

The circular economy is a vast subject that can be approached from a number of different angles. It requires technological skills to propose innovative solutions for reusing co-products or waste. One example is the use of sheep's wool, which is currently little used to make insulation for house building. Another point of view concerns society's expectations. It seems clear that consumers are waiting for emerging proposals in the field of the circular economy and the recovery of co-products and waste. But these ideas need to be built into an economic model that also works.

Another point we discussed, when it comes to products resulting from new processes that promote the circular economy, a recurring problem is the quality of the product generated. Depending on the type of goods, particularly in Europe, there are standards criteria to be met (product quality, lifespan, safety, etc.). Often, as a new process, it is difficult to achieve the quality and safety standards while combining the economic and even societal aspects. Finally, we raised the issue of political leaders and how we can propose innovative solutions and waste recovery schemes.

Nevertheless, the proposals made can take time to be accepted and deployed by politicians, and this can vary greatly depending on the area: rural, mountain, etc.

Within the framework of Unita, ideas could be put together incorporating these different approaches: technological, societal, in order

to propose multidisciplinary projects to answer to future calls in the new hub Circular Economy and Environment.



***About the Author:**

Dr. Karine BRUGIRARD RICAUD is an Associate professor at Université de Pau et des Pays de l'Adour (UPPA).

EDUCATION

2004 PhD in Molecular Microbiology, University Lyon1, France

2001 Master in Microbial Ecology, University Lyon 1, France

1999 Bachelor in Cellular Biology and Physiology, Université Paul Sabatier, Toulouse, France

RESEARCH ACTIVITIES

2009-... Associate Professor, UMR INRAE-UPPA « Nutrition Metabolism Aquaculture ». 2005-2008 Post-doctoral researcher, Washington University of Saint Louis, Groisman Lab 2001-2004 PhD Student, UMR1133 INRA-Univ Montpellier2 EMIP, France

RESEARCH PROJECTS

National: 13 as PI (including a PRC ANR obtained in 2022) and 4 as participant

International: 1 as PI (FEAMP project)

RESEARCH TRAINING

Undergraduate (n=5 students); Master (n=3 students); PhDs (n=4 PhD students + 1 PhD for 4 months (grant from Spain coming for atraining)) ; One post-doctorate

SCIENTIFIC PRODUCTION

n=23 original articles in international journals, n=22 communications (with 1 as invited speaker) https://orcid.org/0000-0003-3839-3121

5 illustratives publications (https://orcid.org/0000-0003-3839-3121)

1. R Defaix, J Lokesh, L Frohn, M Le Bechec, T Pigot;, V Véron, A Surget, S Biasutti, F Terrier, Sandrine Skiba-

Cassy, Jérôme Roy, S Panserat, K Ricaud. Exploring the effects of dietary inulin in rainbow trout fed a high-starch, 100% plant-based diet. Journal of Animal Science and Biotechnology, 2024b, 15(1), pp.6.

2.R Defaix, J Lokesh, M Ghislain, M Le Bechec, M Marchand, V Véron, A Surget, S Biasutti, F Terrier, T Pigot; S Panserat, K Ricaud. High carbohydrate/ protein ratio promotes changes of digesta-associated gut microbiota composition and host metabolism in carnivorous rainbow trout (Oncorhynchus mykiss) fed plant-based diet. (2024a). Aquaculture 578, 740049.

3.J Lokesh, M Delaygues, R Defaix, M Le Bechec, T Pigot, M Dupont Nivet, T Kerneis, L Labbé, LGoardon, F Terrier, S Panserat, K Ricaud. Interaction between genetics and inulin affects host metabolism in rainbow trout fed a sustainable all plant-based diet. British Journal of Nutrition.2023.1-16.

4.J Lokesh, M Ghislain, M Reyrolle, M Le Bechec, T Pigot, F Terrier, J Roy, S Panserat, K Ricaud. Prebiotics modify host metabolism in rainbow trout (Oncorhyncus mykiss) Fed with a total plant-based diet: Potential Implication for microbiome-mediated diet optimization. Aquaculture. 2022. Vol 561 (738699).

5.C Knudsen, J Arroyo, M Even, L Cauquil, G Pascal, X Fernandez, F Lavigne, S Davail, S Combes, K Ricaud. The intestinal microbial composition in Greylag geese differs with steatosis induction mode: spontaneous or induced by overfeeding. Animal microbiome. 2021: 3 :6

4.6. UNITAed we can!

Ion IMBRESCU*
West University of Timișoara, Faculty of Economics and Business Administration, Department of Economics and Economic Modelling

The climate is changing on Earth with an intensity that can be observed from year to year. Economic activities generate huge emissions of gasses and the increasing of annual average temperatures pass 1°C from decades and that determine negative modifications in atmospheric conditions, ocean air circulation and rainfall and they are obvious different from the modification induce by the natural weather variability. So, the necessity of scientific research is evident, because states must have the right instruments to reduce the impact of these negative modifications.

If we think at the state as political institution it is obvious that we cannot think that the politicians cannot take right measures due to a lot of motives. This consecrate the role of scientific research, especially realized in universities to define the concepts, to underline the danger of maintaining of a status-quo in economic activities, to generate plans of actions and to explain how these plans can be implemented. When many universities put their efforts in common is clear that the role will be characterized by synergy. And UNITA became more and more a community of university that can assume this important role and is a clear fact that circular economy represents one of the main scientific research areas for all universities implied in this consortium.

The universities play a major role in sustainable development and the results was visible, but the negative impacts of climate change are more visible and that impose a shift to something that can be implemented as public policy in a rapid way. The circular economy is not only a theoretical concept, it is necessarily to give practical results not in short term but in a medium term. For decades the most important word in economy was (and still is) the profit, and the maximization of profit in a linear economy cannot

be realized without a huge waste of ground materials and physical and moral used goods. UNITA can represent for all home countries an opportunity for the transition from a linear to a circular economy. The general framework must be the Circular economy action plan adopted by the European Commission and the improvement of the future CEAPs must be done by the contribution of universities. But, first, university must develop specific study programs and a lot of workshops, training or just informing sessions oriented not only to the students but also to the other actors of economic, social, political and cultural spaces. First, universities will be forced to give their own examples using rethinking of the campuses in a very close way to circular economy principles and to transmit the ideas that all citizens must to evade from a so call "civilization of garbage" to a civilization of repairing and reusing as many goods as possible. Second, the research activities in circular economy must be intensified, not only in technical approach but also in economic and psychological aspects, not only at high scientific level but also at the level of student-led-projects and to promote as much as possible dual education (to increased the number of absolvents with more practical skills) because this will contribute to fill the new job places generated by the necessity of repairing more and more goods. Third, the universities can increase the critical thinking and attitude to the actions (or non-actions) of politicians, because I think that circular economy rules cannot be applied without strong implemented policies, so maybe is a must that universities to use their influences to convince the politicians to use the brake of CEV (circular economy vehicle) as less as possible. Fourth, when direct education is not possible, members of academic body can use their own relationship to offer support for the villages that are not so closed to a circular economy civilization. In Romania, for example, the mayors have a huge influence over the fellow citizens so for teachers from universities is important not only to think as an educational supplier but rather as a honorific scientific counsellor if we consider that more than 80 percent of rural stand with outstretched hand to regional and/or central government so they have a perfect excuse to not do what have to do to consecrate the values of circular economy.

The framework for a good implementation of circular economy must be built for mountain rural area and the efforts of universities must be oriented also to built integrated development strategy for mountain areas to multiply the effects of our contribution in promoting circular economy values, and the good practices revealed by the fore academic activities of

the UNITA universities can contribute to reduce the specific gap between our countries.

Circular economy probably will not directly contribute to our redemption but can contribute to our forgiveness in face of our descendants and not only. In one of an interesting paper, Younes Nademi and Ramin Khociani tried to present a relationship between happiness and circular economy. Despite the using a high level of rationality if we think that happiness implies a lot of emotions, they concluded that between happiness and circular economy there is a strong positive relationship, not only at individual level but also at societal level. And that contributes to a more inclusive society.

The importance of circular economy for live conditions on Earth is obvious for us but there are archaeological proves that was important also for our ancestors and probably is infinitely more important for our descendants because is a decisive element of achieving SDGs.

So, UNITAed we can contribute to circular economy! UNITAed can be happy!



***About the Author:**

Ion IMBRESCU is Associate Professor, head of Department of Economics and Economic Modelling, Faculty of Economics and Business Administration (Economics field), West University of Timisoara (Romania). He teaches Microeconomics, Macroeconomics, Economic Policy and Economics of Cultural Heritage. The research field is related to economic growth, underground (informal) economy, cultural economics, institutional economics. He is also involved in economic and social life of a small village situated in a mountain area of Banat and tries to contribute to a transition to green economy but also in preserving the traditions, customs and crafts. He is interested in developing economic and social indicators of circular economy and how can they be used in rural mountain space.

4.7. The role of universities in education for a sustainable future through the Circular Economy

Nicoleta SÎRGHI*
West University of Timișoara, Faculty of Economics and Business Administration, Department of Economics and Economic Modelling

Topic 1: What role can UNITA play in promoting the circular economy?

UNITA can play a crucial role in promoting the circular economy in several ways:

- *research and innovation*: research can be carried out to advance knowledge and develop innovative technologies, processes and business models that support the transition to a circular economy. This includes research into sustainable materials, resource recovery, waste reduction and circular design principles.
- *education and capacity building*: by educating students, professionals, and policymakers, UNITA build capacity and promote a deeper understanding of the circular economy concept and its potential benefits.
- *knowledge transfer and collaboration*: through partnerships, joint research projects, and collaborative initiatives, UNITA facilitate the co-creation and dissemination of knowledge, technologies, and best practices related to the circular economy.
- *entrepreneurship and incubation*: we can support entrepreneurship and innovation in the circular economy space by providing incubation support, funding opportunities, and mentorship programs to startups, spin-offs, and social enterprises. By nurturing entrepreneurial talent and fostering a culture of innovation, UNITA stimulate economic growth and job creation in circular.

Topic 2: How can the circular economy contribute to job creation?

Overall, the circular economy offers a wide range of job opportunities across different skill levels and sectors, contributing to economic growth while promoting sustainability and resource efficiency:

- *recycling and resource recovery*: implementing efficient recycling systems requires workers in collection, sorting, processing, and recycling facilities. Additionally, innovation in recycling technologies can lead to new job opportunities in research and development
- *resource management and optimization*: companies need experts to manage resources efficiently, minimize waste generation, and optimize production processes. This involves skills in logistics, supply chain management, and waste reduction strategies
- *digital technologies and innovation*: advancements in digital technologies such as blockchain, IoT, and AI enable better tracking and management of resources throughout their lifecycle. This creates demand for jobs in software development, data analysis, and digital innovation
- *consumer education and engagement*: educating consumers about the benefits of a circular economy and promoting sustainable consumption behaviors requires skilled professionals in communication, marketing, and outreach.

Topic 3: What role can bioplastics and other bio-based materials play in the shift away from non-renewable materials for packaging and products?

Bioplastics and other bio-based materials have a significant role in shifting away from non-renewable materials for packaging and products:

- *promoting circular economy principles*: bioplastics can contribute to circular economy practices by being designed for recyclability, compostability, or biodegradability. this enables the recovery and reuse of resources, closing the loop and reducing the need for virgin materials
- *supporting rural economies and agriculture*: the production of bio-based materials often involves agricultural or forestry activities, providing opportunities for rural communities and farmers. Bioplastics offer a viable alternative that aligns with consumer

preferences and regulatory requirements, driving market demand for bio-based materials.

- *collaboration across supply chains*: the adoption of bioplastics and bio-based materials requires collaboration across supply chains, involving manufacturers, retailers, consumers, waste management facilities, and policymakers. This collaborative approach fosters partnerships and innovation throughout the value chain, accelerating the transition to sustainable packaging and products.

Topic 4: How can the circular economy contribute to a more just and inclusive world?

The circular economy holds great potential to contribute to a more just and inclusive world by addressing social, economic, and environmental challenges:

- *social innovation and entrepreneurship*: circular economy principles stimulate social innovation and entrepreneurship by encouraging the development of sustainable business models and solutions that address societal challenges. Social enterprises focused on circular economy initiatives, such as community-based recycling programs and inclusive supply chains, contribute to poverty reduction, social inclusion, and community development.
- *job creation and economic opportunities*: by promoting local and decentralized production systems, the circular economy can provide employment opportunities, particularly in marginalized communities and sectors with high unemployment rates, thus reducing income inequality and promoting economic inclusion
- *resource efficiency and conservation*: by conserving natural resources and reducing pollution, the circular economy helps mitigate the adverse impacts of environmental degradation on marginalized communities, which are often disproportionately affected by pollution and resource depletion
- *policy and institutional reforms*: by integrating social objectives into circular economy policies and strategies, governments can ensure that the benefits of the circular economy are equitably distributed and that no one is left behind in the transition to a sustainable and inclusive future.

Topic 5: How can research developed within UNITA universities help companies (and countries) align circular economy initiatives with climate goals?

Research developed within UNITA universities can play a crucial role in helping companies and countries align circular economy initiatives with climate goals in several ways:

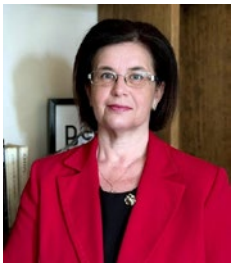
- *Life Cycle Assessment (LCA)*: UNITA universities can conduct research using LCA methodologies to assess the environmental impacts of different circular economy strategies and compare them with traditional linear approaches. This research can help companies identify opportunities to reduce their carbon footprint and improve resource efficiency throughout the product lifecycle
- *waste reduction and valorization*: UNITA universities can explore ways to minimize waste generation and maximize the valorization of waste streams through recycling, composting, and other circular economy practices.
- *circular design and innovation*: researchers can collaborate with companies to develop circular design principles and innovative products that prioritize resource efficiency, durability, and recyclability.
- *multi-disciplinary collaboration*: UNITA universities can facilitate multi-disciplinary collaboration between researchers, companies, and policymakers to address complex challenges at the intersection of circular economy and climate change. By bringing together expertise from diverse fields such as engineering, economics, environmental science, and policy studies, UNITA universities can foster innovation and develop holistic solutions that contribute to climate goals.

As future research directions within UNITA, topics related to the dual green and digital transition could be investigated, from the perspective of:

- *sustainability*: the ecological transition addresses environmental challenges, while the digital transition enables more efficient use and management of resources.
- *economic growth*: the adoption of digital technologies can stimulate innovation, improve productivity and create new business opportunities. at the same time, investments in green sectors can create jobs and stimulate economic activity.

- *resilience*: focusing on sustainability and digitization can increase resilience to environmental risks, such as the impact of climate change or resource scarcity, as well as to economic disruptions.
- *inclusion*: efforts to promote sustainability and digitization should also aim to ensure that benefits are shared fairly across society, minimizing inequalities and promoting social inclusion.

In conclusion, the ecological and digital transitions are global phenomena, and their impact on the labor market varies across countries and regions, depending on factors such as economic structure, workforce demographics and political frameworks.



***About the Author:**

Nicoleta SÎRGHI is a Full Professor, PhD habil. and a PhD coordinator within the Doctoral School of Economics and Business Administration (Economics field), at the West University of Timisoara (Romania), Faculty of Economics and Business Administration. The current research field is related to the study of economics and game theory with applications in economics. She is a member of the scientific council of the ERECO-PGV network and a member of professional economics associations: Regional Science Association International, International Association of French Speaking Economists, and the ERECO-PGV network. She has published in the International Journal of Bifurcation and Chaos, Sustainability, Transformations in Business and Economics, Journal of Economic Computation and Economic Cybernetics Studies and Research, etc. Recent publications include articles on corporate social responsibility and circular economy. She is a member of the Timisoara Journal of Economics and Business editorial board and a reviewer for many international journals and conferences.

5. FROM THE RENEWABLE ENERGIES WORKSHOP

PART I. Research Projects in Renewable Energies

5.1. Research Challenges for renewable energies

María Paz Comech*
University of Zaragoza

This contribution details the preparation and results of a project called ENSURE (Ecological Transition in Rural Areas) developed by the ENERGAIA research institute (Joint University Research Institute of Energy and Resource Efficiency of Aragon).

When we were preparing the proposal, we assumed these starting points: It had to be a project related to energy transition; it must take advantage of the knowledge of the different groups from ENERGAIA about Renewable energy, Sustainability and Efficiency of resources, and it should have applicability in the region of Aragon. Therefore, the first steps were analyzing the aspects of energy transition, the characteristics of Aragon and the challenges associated to energy transition in Aragon.

In Aragon, it has a total of 731 municipalities. Regarding the population, a total of 1,321,000 people live in the city of Zaragoza, 666,888 of whom live there. Of the 731 municipalities, 28% have less than 100 inhabitants, 46% between 100 and 500 inhabitants, 19% between 500 and 2000, and only 7% have more than 2000 inhabitants. Therefore, rural areas occupy a large part of the Aragonese territory with few inhabitants. This fact has implications for the quality of services such as communications or energy supply in these areas. Still, it also implies that there are large areas with immense energy resources such as water, wind and the sun that can provide improvements in these services for the people who live there.

Regarding the energy transition, the project should be focused on the PNIEC (Plan Nacional Integrado de Energía y Clima) objectives that are:

- 32% reduction in greenhouse gas (GHG) emissions compared to 1990.
- 48% renewables on the final use of energy.
- 44% improvement in energy efficiency.
- 81% renewable energy in electricity generation, and
- Reduction of energy dependency in 51%

The electrification and decarbonization of the energy system includes:

- Electrification of thermal demand: transportation and air conditioning/heating
- Deployment of renewable energies.

Concerning this last point, the document of the PNIEC talks about the promotion of large generation projects, deployment of self-consumption and distributed generation and measures to promote flexibility, such as energy storage or demand management, to promote the integration of renewables into the electricity system and market.

After these analyses, and always considering the need of maintaining the rural way of life of the inhabitants of these rural areas and the sustainability of the energy transition, the project objectives do not consider the development of large generation projects, but rather the deployment of self-consumption and distributed generation and measured to promote flexibility.

Then, the main objective was described as: "ENSURE project aims to provide technical solutions for the ecological transition in rural areas. The project addresses two significant challenges: the decarbonization of the economy and the development and improvement of life quality in rural areas and it tackles it from a global perspective by developing a set of new technologies and techniques, analyzing them not only individually but also their complementarity, also considering their environmental footprint and socio-economic impact. The goal is to contribute to a fully sustainable management of the rural environment with a quality of life comparable to the urban environment".

The approaches of the project were:

- provide a technical solution that truly enables the massive integration of renewable energies in those areas,
- develop sustainable use of biomass for various purposes, both for direct use in boilers that also include a Stirling engine for

electricity production, as well as in the production of biochar for various valuable applications,
- analyse the thermal heating systems based on electricity and their combination with biomass support to provide the required comfort in dwellings, and
- include of the circular economy applied to massive electric use in the rural environment, through second-life batteries

As this project addresses this topic from different points of view, it was divided into a series of tasks that are described below.

Rural grids enhancement by the integration of distributed energy resources

The starting point of this task is the analysis of how the connection of a large number of small generators, electric vehicles and air conditioning systems can impact rural electrical networks. To face this research, it is necessary to consider the characteristics of rural networks, which are weak networks with a radial configuration and long lines. On the other hand, in the event of a failure in these networks, the number of consumers will be lower. Still, the difficulty of finding the point of failure causes repair times to increase. The classic solution in these cases is to make investments that strengthen the network, such as installing new lines and substations. However, the cost of these solutions often makes them unviable due to the small number of users. Hence, searching for solutions that do not require the construction of new electrical infrastructure is vital for improving services in these rural areas.

At this point, it is vitally important to know in detail what the networks are like and the consumption behaviour in these areas. For this part of the project, Endesa e-distribución participated through the "Innovation and Energy Sustainability Endesa Chair" at the University of Zaragoza by contributing their experience and information to obtain results and solutions that are close to reality.

The first analysis of this task allows determining the current limitations and the bottlenecks of the network to the connection of the new elements by modelling and simulating a real rural distribution network (LV and MV). Bus voltages, overloading or other power quality aspects were analyzed. The objective was to define, different scenarios considering the renewable penetration level, electric loads connection and storage facilities.

After defining the limitations to the new installation connection, several solutions have been analyzed to allow the increment of the penetration levels of RE and electric loads. Between these solutions are:

- The control of the new installations connected to the grid. For example, controlling the charging of the vehicles during the night to avoid undervoltages
- Connecting a 4-branch D-FACTS.

The 4-branch D-FACTS is a power electronic equipment connected between the three phases and the neutral in low voltage networks. This device can balance the phase currents, control reactive power for each phase independently and eliminate harmonics.

Thanks to this research about the connection of electric vehicle in rural networks was published:

Comech MP, Sanz-Osorio JF, Melero JJ, García-Izquierdo O. Impact of the Integration of the Electric Vehicle on Low-Voltage Rural Networks. Applied Sciences. 2024; 14(6):2638. https://doi.org/10.3390/app14062638

As an example, this figure shows the following figure shows the comparison of the minimum voltage, the maximum loading, the unbalance factor, and the power losses in four scenarios, which are defined as:

- Scenario 1 (in orange): The charge of the electric vehicles is produced at night without any control or solution implanted. In this case, there is a problem of undervoltage, and the values of maximum loading, unbalance factor and losses are the worst in the comparison.
- Scenario 2 (in grey): Show the results when introducing the proposed control. This control limits the current of the charging stations to avoid undervoltages. In this case, the undervoltage problem is solved, and the maximum loading and power losses are reduced significantly, but the unbalance factor remains in high values during the night.
- Scenario 3 (in yellow): Show the results when the D-FACT is connected to the optimal point of the circuit. The rated power of the D-FACT in this simulation is 60 kVA. The undervoltage problem ameliorates in this case, but the minimum voltage is still under 0.9 p.u. Besides, the results of the maximum loading and the power

losses are worse than in Scenario 2. However, the unbalance factor is reduced significantly.

- Scenario 4 (in blue): Show the results of combining the proposed control and a D-FACT of 30 kVA. In this scenario, all the analysed parameters improve.

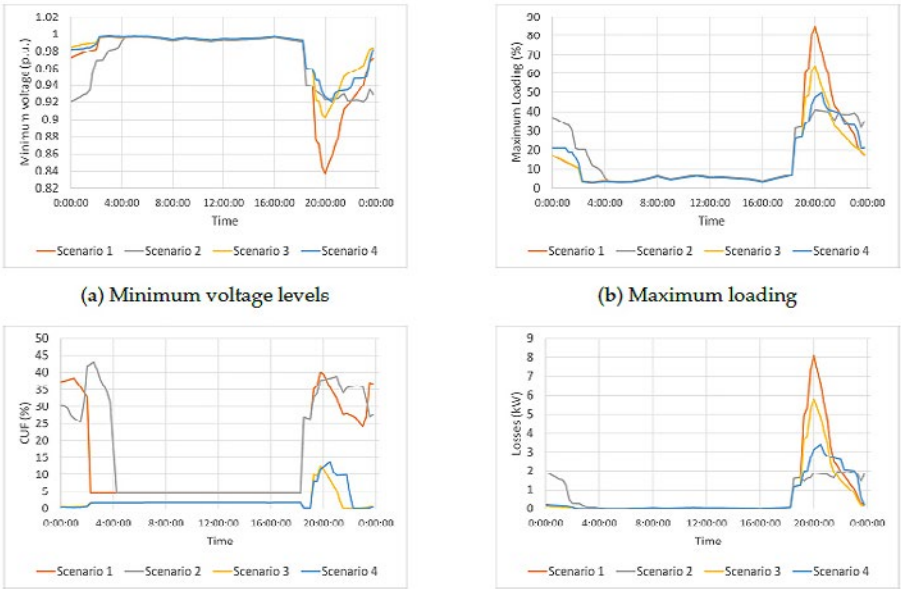


Figure 1. Results of the connection of charging stations for electric vehicles

On the other hand, this project proposes using second-life batteries to solve the storage and consider sustainability approaches. Second-life batteries can be applied for different uses after their initial lifecycle, reusing them in different but effective ways. The development of viable second-life batteries and battery packs can reduce the amount of waste and prevent the additional depletion of Earth's minerals.

This project aims to use electric vehicle batteries to support electric power systems in rural areas. However, for this type of battery to be viable, it is necessary to analyze their behaviour, considering their characteristics after their first lifecycle, to find the most appropriate uses for each case. Therefore, the first step is to characterize the ageing of the cells and their modelling to realize the diagnosis of the state of the cell.

The lifecycle of the battery used in electric vehicles is characterized by ageing performed in the laboratory. This characterization considers eight years of use and different charging and driving profiles. The lab tests are carried out using the cycler and the laboratory's climatic chamber to check the cells' behaviour before, during and after the ageing process. The following picture shows the lab testbench used in these tests:



Figure 2. Lab testbench for batteries characterization

Once the tests are performed and the results analyzed, the batteries can be modelled and simulated to find the best application depending on their state considering their electrical model, to obtain its State of Health (SoH), the internal resistance and the operating limits in charge and discharge.

Renewable nano-structured materials for energy and e-mobility applications

This part of the project is devoted to characterizing renewable materials (biomasses of different origins) as raw materials for producing char with nanostructure (activated carbon).

The production of activated carbon from a carbonaceous precursor material by the physical activation route occurs in two stages: carbonization (or slow pyrolysis) and activation (partial gasification in a reducing atmosphere). The conditions in which each process stage takes place, such as the final temperature, residence time, heating rate (°C/min) and gas flow

rate, are relevant factors in the properties achieved in the final activated carbon. The optimization of these conditions allows obtaining a final product with a greater specific surface area and microporosity. An experimental test campaign has been carried out in a tubular furnace to optimize the quality of the final nanocarbon materials through the conversion rate and the developed porous structure (specific surface area, total pore volume and pore size distribution). The following picture show the lab testbench used in these tests.



Figure 3. Lab testbench for activated carbon production from biomass

The next step is to develop a predictive model of the significant properties of activated carbon to predict the properties of final activated carbon (conversion and porous structure) obtained from carbonaceous biomass material by the physical activation process (the most common activated carbon production process), a predictive model based on the intrinsic properties of the material and the conditions under which the process takes place are developed.

In this part of the project, this paper was published:

Pallarés Ranz, Javier & Gil, Antonia & Cortés, Cristóbal & Arauzo, Inmaculada, 2024. "Modeling of the evolution of the porous structure during a physical activation process for the production of activated biocarbon: A novel low conversion approach," Renewable Energy, Elsevier, vol. 224(C). DOI: 10.1016/j.renene.2024.120170

Integrating biomass and electrification in rural areas

This part of the project can be divided into two parts. The first part is the integration of biomass into electric power demand, and the second one is the integration of biomass into heating demand.

For integration biomass into electric power demand microcogeneration (CHP) unit incorporating a condensing biomass boiler (25 kWth) and a 1 kWeFree-Piston Stirling engine (FPSE) for self-consumption of thermal energy and power, with an emphasis on not relying on solar energy. This system is particularly suitable for wet or poorly insulated regions.

The research is geared towards assessing the impact of fouling in the FPSE resulting from varying biomass combustion scenarios and different part-load conditions of the biomass boiler. The system's heating requirements for climate control and domestic hot water influence these variations. Next figure shows the lab benchmark used in this part of the project.



Figure 4. Lab testbench for microgeneration analysis

In the second part, the objective is to cover the total demand for heat in periods in which the air-water heat pumps (AWHP) could not operate in optimum conditions (very low temperature and high humidity, or deficient capacity of the AWHP since it is only fed by solar energy which is limited in some periods).

The following figure shows examples of the simulations performed to optimize the integration of AWHPs and biomass boilers to Combine simulation in Design Builder (detailed consumption for heating and cooling, up in the figure) and TRNSYS for the optimized installation (down in the figure).

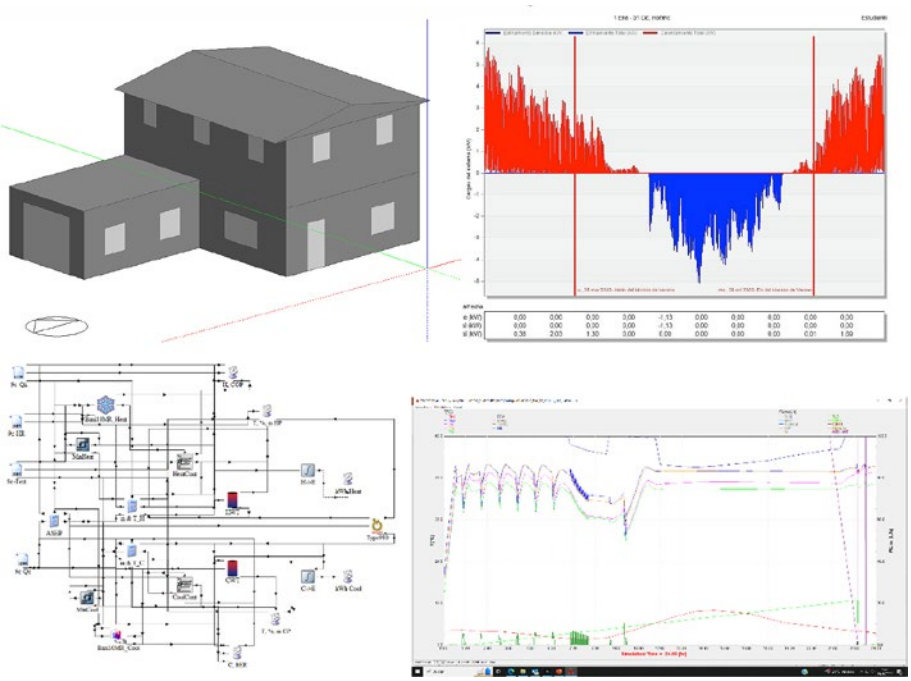


Figure 5. Simulation results obtained with Design Builder (up) and TRNSYS (down)

WP5: Socio-economic and material footprint analysis

In addition to the tasks associated with the technical, experimental and simulation activities, two cross-cutting project tasks are related to the sustainability of the energy transition in rural areas: socio-economic impact and raw material footprint.

Given that the project deals with the rural environment and "Empty Spain", it is essential to make a weighted and realistic estimate of the socio-economic impact of these solutions, in terms of jobs, but, above all, of the prospects of population settlement and attraction effect on the regions analysed.

At this point, it is essential to highlight the aspects of the digital transformation that may affect the proper development of the solutions proposed in the project since it is vital to have both an adequate

infrastructure and training in line with the new technologies, which is not always feasible in ageing counties that are often reactive to adopting new forms of management and governance of supplies.

The target of the energy communities is beyond those of collective self-consumption, which is mainly focused on the economic aspect. In addition to the increased concern about the generation and distribution facilities and infrastructure, energy communities aim to maximise the local benefits and environmental and social sustainability.

The general approach underlying this is to provide a more detailed analysis of the impact of the energy communities in creating local wealth and compare it with other forms of energy supply. In particular, it aims to analyse and demonstrate the intrinsic characteristics of employment directly related to the solutions proposed by the project, providing quantitative data and qualitative analysis that will point out the challenges of having a territory to enable the transition to a sustainable economy. When this contribution was developed, the results of this part were under analysis, and no results could be shown.

The raw material footprint analysis aims to corroborate that the technological solutions provided in the project are sustainable by calculating the material footprint, which includes the cost of manufacturing the materials in terms of natural (mineral) resources and the energy associated with using these resources.

The material footprint of the processes included in the project is assessed considering their quality through a novel indicator called thermodynamic rarity, a second law-based indicator developed at our institute that accounts for the relative scarcity of the resource in the crust and the energy intensity to mine and refine it. As such, we can answer critical questions such as whether the technological solutions proposed in the project for the electrification of rural areas are feasible regarding raw material supply needs. In this point, a paradox has been found: "the more efficient technologies are less efficient from a material point of view". This paper has been published regarding this topic:

Martín Lallana, Jorge Torrubia, Alicia Valero, Metals for energy & digital transition in Spain: Demand, recycling and sufficiency alternatives, Resources, Conservation and Recycling, Volume 205, 2024, 107597, https://doi.org/10.1016/j.resconrec.2024.107597.

A hopeful result must be highlighted between the results from this publication since, with an adequate recycling plan for the systems associated

with the energy transition, the shortages expected in the not-too-distant future can be avoided, as can be seen in the following picture, which shows the percentage of the demand from Spain's energy and digital transition that different recycling technologies could meet. The proposition of this paper is called Alternative 6 (in blue). It allows the coverage of all the analysed raw materials to increase compared with the current recycling rates (in orange).

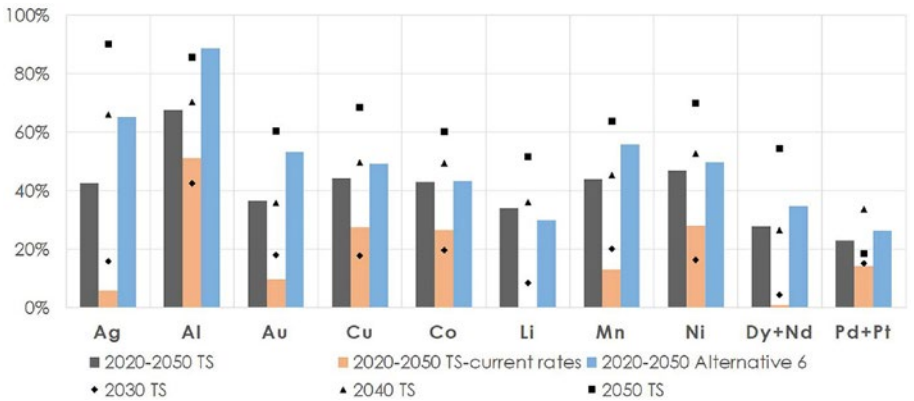


Figure 6. Percentage of the demand for the Spanish energy and digital transition met from the recycling of the technologies considered

Aknowledgments

The research described in this report has been developed thanks to the grant TED2021-131397B-I00: "Transicion ecologica en areas rurales" funded by MCIN/AEI/10.13039/501100011033 and by the European Union Next Generation EU/PRTR and the Grant of the Innovation and Energy Sustainability Endesa Chair at the University of Zaragoza.



***About the Author:**

María Paz Comech has been a Doctor in Electrical Engineering from the University of Zaragoza since April 2008 with a thesis titled "Analysis and testing of wind systems in the face of voltage dips".

Currently, she is developing her research career at the ENERGAIA Joint University Research Institute within the group T41_23R: Intelligent Optimization of the Generation and Integration of Renewable Sources

(SMART-e), of which she is the principal researcher.
Its main lines of research include:

- The study of integrating renewable generation and distributed resources and its possible impact on energy quality.
- The analysis and development of new smartgrid structures and new grid control and automation algorithms to improve efficiency and security, and
- Modelling, simulation, and analysis of electrical systems using different software such as PSCAD, PSS/E or DIgSILENT PowerFactory.

She has participated as a researcher in more than 120 R&D&i contracts with private funding, seven national projects and four belonging to European funding. Among them is the ENSURE project that she is going to present today.

5.2. Modeling and measurements of solar radiation at West University of Timisoara

Andreea Sabadus*
West University of Timisoara - Institute for Advanced Environmental Research

Abstract:

The research on photovoltaics at the West University of Timisoara begun in 2000 and experienced an impressive development after the commissioning of the Solar Platform in 2008. The main component of the Solar Platform is the Solar Radiation Monitoring System which marked a pioneering achievement as the first radiometric station in Romania specifically designed for systematic monitoring of solar radiation on tilted surfaces. Currently, the Solar Energy Research Group (SERG) from the West University of Timisoara is focused on three well defined fields: (1) Modeling Solar Radiation at the Earth Surface; (2) Modeling the solar cell operation; (3) PV power forecasting. (1) A parametric model for estimating solar irradiance under clear sky condition, SIMv.2, was developed. The model's performance was confirmed in an independent global evaluation, SIMv.2 being ranked first worldwide in estimating diffuse irradiance under clear sky conditions in temperate climate. (2) The one-diode model parameters of a PV modules are estimated at Standard Test Condition and then used to estimate the output power from in-plane measurements of solar irradiance and air temperature. (3) In terms of intra-hour PV power forecasting, the PV2-state model was developed. The model incorporates real-time adjustments to the estimated clear-sky PV power or the transmittance of clouds, considering the Sun coverage by clouds.

1. Solar Platform

Research on photovoltaics at West University of Timisoara begun in 2000 and underwent significant advancement following the commissioning of the Solar Platform in 2008 [1]. The central component of the Solar Platform is the Solar Radiation monitoring system, representing a groundbreaking

milestone as Romania's first radiometric station specifically designed for the systematic observation of solar radiation on inclined surfaces. The FORPV setup (Fig. 1) was designed to test and evaluate models used for estimating and forecasting PV power. It comprises a PV system with a total capacity of 540 Wp, consisting of four Cleversolar SPR-135 PV modules positioned at a 30-degree angle. These modules are connected in a series-parallel configuration and directly supply power to a resistive load.



Figure 1. FORPV experimental setup located at the Solar Platform
at West University of Timisoara

To measure the in-plane solar irradiance, a high quality Kipp & Zonen SMP-10 pyranometer (class A, ISO9060:2018) is used. Furthermore, meteorological data is recorded using a Delta-T Devices WS-GP2 weather station. All these instruments undergo a 24/7 monitoring, with data recorded at regular intervals of 4 seconds. Also, an EKO Instruments ASI-16 all-sky imager is used for monitoring the state-of-the-sky at 1-min sampling.



Figure 2. CE318-T Sun Sky Lunar Multispectral Photometer from CIMEL
and a MS-711N spectrometer from EKO Instruments

Recently, an extension of the Solar Platform was put into operation at the Institute for Advanced Environmental Research. A second All Sky Imager was installed. Also a CE318-T Sun Sky Lunar Multispectral Photometer from CIMEL registered in AERONET [2] and a MS-711N spectrometer from EKO Instruments with a resolution of 1nm were installed (Fig. 2).

2. Modeling solar radiation at the Earth surface

One of the main instruments developed within SERG in modeling solar radiation is SIMv.2. SIMv.2 is an improved version of the initial SIMv.1, with the objective of increasing the accuracy of estimating the diffuse component of solar irradiance. The model was published in 2018 [3] and subsequently included in several studies evaluating the performance of solar irradiance models globally. In 2020, the achievement of the proposed objective was confirmed by the study [4], which places SIMv.2 in the first position worldwide in terms of estimating diffuse solar irradiance in temperate climates. Following is a brief presentation of the SIMv.2 model.

For the development of SIMv.2, two types of data were used: information about the atmospheric column content, representing the input parameters of the model, and radiometric data necessary for model calibration and accuracy evaluation of estimates. The input parameters include ozone content, nitrogen dioxide, and water vapor in the atmospheric column, as well as optical parameters of aerosols. The input parameters were collected from the Aerosol Robotic Network AERONET [2]. Global and diffuse solar radiation data were collected from the Baseline Surface Radiation Network BSRN [5], from 16 stations. The selection criterion for stations was the coexistence of an AERONET and a BSRN station in the same location. AERONET and BSRN stations do not indicate whether the data were measured under clear sky conditions. Therefore, it was necessary to explore a large amount of data to identify measurements taken during clear sky periods. We remind here that clear sky is defined by the absence of any cloud in the sky. The selection was made in three steps. The first step was based on the analysis of the fractal dimension of the radiometric data recorded in a day [6]. For further processing, only those days with a fractal dimension less than 1.1 were selected. The second step involved comparing the measured global solar irradiance with the estimation given by a simple empirical clear sky model. Upon detecting the presence of a cloud, the entire day was removed from the database. The last step involved visual

inspection of the solar radiation curves measured by both the BSRN and AERONET stations. This final step, carried out manually, ensured that the database contains only data measured under perfectly clear sky conditions.

SIMv.2 estimates the horizontal global radiation *G* as the sum of the direct component G_b and the diffuse component G_d:

$$G = G_b + G_d \tag{1}$$

G_b and G_d are expressed as a function of the solar elevation angle *h*:

$$G_b = G_{SC}\varepsilon\overline{\tau}_b \sinh \tag{2}$$

$$G_d = G_{SC}\varepsilon\overline{\tau}_d \sinh \tag{3}$$

G_{SC}=1366.1 *W/m*^{2} is the solar constant, *h* is the solar elevation angle, and ε is a correction factor due to the variation of the Sun-Earth distance, which can be calculated using the Spencer equation [7]. $\overline{\tau b}$ and $\overline{\tau d}$ are the direct and diffuse atmospheric transmittances, respectively.

The direct atmospheric transmittance takes into account the most important atmospheric attenuators: ozone ($\overline{\tau}_{O3}$), nitrogen dioxide ($\overline{\tau}_{NO2}$), water vapor ($\overline{\tau}_w$), gas mixture ($\overline{\tau}_g$), Rayleigh scattering ($\overline{\tau}_R$), and aerosol absorption ($\overline{\tau}_a$). Thus, the direct transmittance is given by the equation:

$$\overline{\tau}_b = \overline{\tau}_{O3}\overline{\tau}_{NO2}\overline{\tau}_w\overline{\tau}_g\overline{\tau}_R\overline{\tau}_a \tag{4}$$

The ground-level diffuse radiation is calculated as the sum of two individual components corresponding to Rayleigh scattering ($\overline{\tau}_{d,R}$) and aerosol scattering ($\overline{\tau}_{d,a}$) processes:

$$G_d = G_{SC}\varepsilon\overline{\tau}_{d,R} \sinh + G_{SC}\varepsilon\overline{\tau}_{d,a} \sinh \tag{5}$$

Therefore, the diffuse transmittance will itself be a sum of two terms:

$$\overline{\tau}_{d,R} + \overline{\tau}_{d,a} = \gamma_R\overline{\tau}_{d,O3}\overline{\tau}_{NO2}\overline{\tau}_w\overline{\tau}_g\overline{\tau}_{aa}\left(1-\overline{\tau}_R\right) + \gamma_a\overline{\tau}_{d,O3}\overline{\tau}_{NO2}\overline{\tau}_w\overline{\tau}_g\overline{\tau}_{aa}\left(1-\overline{\tau}_{as}\right)$$

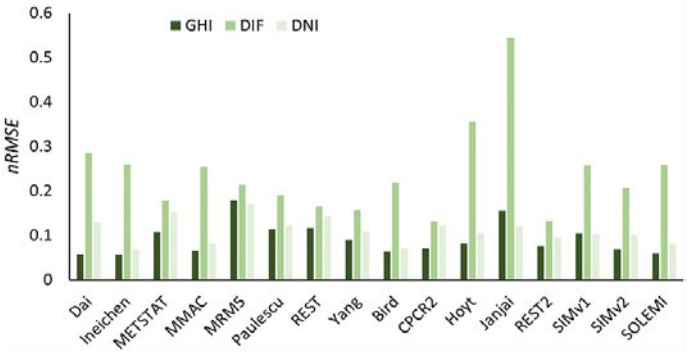


Figure 3. Evaluation of SIMv.2 model performance compared to other models described in [8]. GHI - Global Horizontal Irradiance, DIF - Diffuse Solar Irradiance, DNI - Direct Normal Irradiance

The performance of the SIMv.2 model was evaluated from three perspectives: (1) testing based on measured data, (2) accuracy gain compared to the initial version SIMv.1, and (3) comparison with other models. Overall, SIMv.2 exhibits higher performance than SIMv.1, with an improvement in nRMSE of 37.1% for the global component of solar irradiance and 24.7% for the diffuse component. Comparison with 12 other high-performance models for estimating solar irradiance under clear sky conditions showed that SIMv.2 accurately estimates both diffuse and direct components and excels in estimating the global component (Fig. 3).

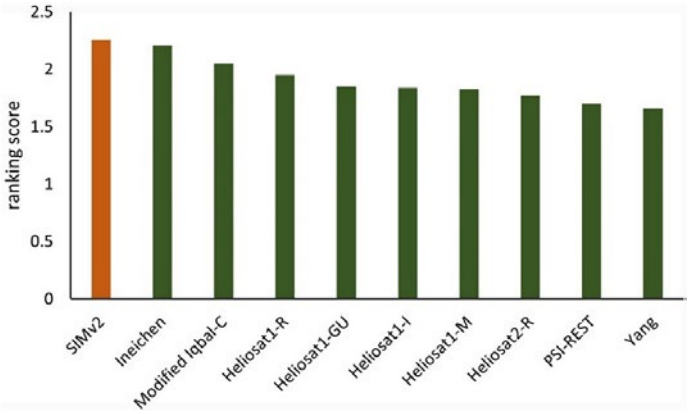


Figure 4. Top 10 performance of models in temperate climates, according to reference [4]

In the year 2020, the SIMv.2 model was included in an accuracy analysis among 95 models for estimating solar irradiance under clear sky conditions [4]. The authors of the study analysed the performance of estimating the direct and diffuse components of solar irradiance at meteorological stations distributed worldwide. SIMv.2 was ranked first globally in estimating diffuse irradiance in temperate climates (Fig. 4). Overall, the model demonstrated excellent performance in estimation across all climatic zones, except for the polar one.

3. Solar cell operation modeling

The current-voltage (I-V) characteristic of a PV module results from the superposition of the I-V characteristics of its component cells. The I-V characteristic measured under standard testing conditions (STC, solar irradiance at normal incidence of 1000W/m^2, with spectral distribution AM1.5G [9] and a cell temperature T=25°C) is a key element in evaluating the performance of a solar cell. Physically, the I-V characteristic depends in a complex manner on the material nature of the cell and its electro-optical properties [10]. Due to its profoundly nonlinear nature, the mathematical modeling of the I-V characteristic of a solar cell, even at STC, is far from trivial.

For crystalline solar cells, nearly all mathematical models of I-V characteristics originate from Shockley's theory of illuminated ideal p-n junctions [11]. The diode model (Fig. 5) is probably the most common equivalent circuit of a real solar cell. The photocurrent I_L is generated by a current source, which linearly depends on the solar irradiance level. The diode D, characterized by the saturation current I_S and the diode ideality factor m, models the so-called dark current of the cell. The parallel resistance R_P arises due to device imperfections, such as interface microcurrents. The R_P resistance contributes to a decrease in the overall cell efficiency. The series resistance R_S takes into account the ohmic losses within the cell. The effective voltage across the parallel grouping is higher than the voltage at the cell terminals, being equal to $V+IR_S$. It is noteworthy that with the advancement of technology for solar cells [12], new versions of the equivalent circuit have been proposed. A good illustration is the double-junction model of perovskite solar cells with planar heterojunctions [13].

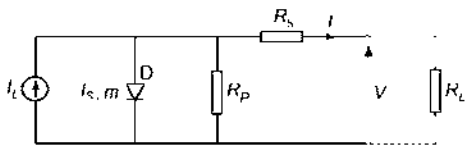


Figure 5. Equivalent circuit for the 1-diode model of a solar cell

Based on the equivalent circuit in Fig. 5, the I-V characteristic equation can be written as follows:

$$I = I_L - I_S \left[\exp\left(\frac{q\left(V + IR_S\right)}{mk_B T} \right) - 1 \right] - \frac{V + IR_S}{R_P} \tag{7}$$

Numerous research studies have focused on the extraction of parameters of the 1-diode model at STC from experimental measurements. However, currently, there is still no universally accepted approach for extracting the parameters of the 1-diode model. In recent decades, various parameter extraction methods have been proposed, ranging from classical methods (such as Newton-Raphson [14] or iterative methods [15]) to sophisticated techniques based on artificial intelligence (such as the competitive imperialist algorithm [16] or the algorithm based on flower behaviour in pollination [17]). A broader picture of modeling the I-V characteristics of a solar cell can be seen in Ref. [18], where over 100 methods for extracting model parameters of a solar cell are classified and reviewed. The strengths and weaknesses of each method class are presented from various perspectives. Generally, the parameters of the 5-parameter model are calculated using equations written at the notable points on the I-V characteristic, more precisely at I_{SC}, V_{OC}, and *MPP,* and also at slopes of the characteristic around I_{SC} and V_{OC} to determine R_S and R_P, respectively. This is a straightforward method, but its accuracy depends on the choice of the points at which derivatives are calculated around I_{SC} and V_{OC}. The experience gained during our studies on the extraction of parameters of the 1-diode model led to the following empirical observation: For a given solar cell, there are several different sets of parameters ($I_{L,}$ $I_{S,}$ m, $R_{s,}$ R_p) which, when substituted into Eq. (7), accurately reproduce the measured I-V characteristic at STC [19]. This observation leads to a fundamental question that we sought to answer during our research: How many distinct sets of parameters can accurately reproduce the I-V characteristic of a given solar cell at STC? Regardless of its nature, an algorithm for extracting parameters of the 1-diode model solves a set of nonlinear equations derived from Eq. (7). Apparently, there are many local minima that prevent the algorithm from finding a global solution.

For estimating the energy generated by PV systems and, simultaneously, for improving the performance of solar cells, modeling their I-V characteristic is essential. As mentioned above, one of the most popular

models of the I-V characteristic of a solar cell is the 5-parameter model (Eq. (7)). Knowing the I-V characteristic within the frame of the 5-parameter model means identifying the values of the five model parameters.

Our study [19] begun with the analysis of a large number of articles published on the topic of extracting model parameters for solar cells. Among these articles, we selected those focusing on three types of PV modules: Kyocera KC200GT, RTC France, and Shell SM55. All modules are commercially available and come with datasheets. The Kyocera KC200GT PV module is commonly used in studies on parameter extraction methods. This is a high-efficiency polycrystalline PV module consisting of 54 cells connected in series. The role of PV modules in parameter extraction studies is to verify the accuracy of parameter extraction methods. In our study, no selection criteria related to PV modules were imposed. We considered any method, from regression methods to metaheuristic methods. The empirical part of the study aimed to identify the set of parameters extracted in different studies, using different methods, and highlight their dispersion.

Table 1 presents the parameters of the 1-diode model obtained in different studies by various authors. Fathy and Rezk [16] propose an approach to parameter extraction based on the competitive imperialist algorithm (ICA). This is an evolutionary algorithm that can be considered the counterpart of genetic algorithms (GA). ICA originates from human social evolution, while GA originates from the biological evolution of species. A metaheuristic algorithm inspired by the flower pollination process, namely the flower pollination algorithm (FPA), is proposed in Ref. [20]. The authors argue that FPA is one of the most efficient algorithms in extracting parameters of the 1-diode model. Alternatively, in [21], a multi-verse optimization algorithm (MVO) is proposed. MVO is one of the algorithms recently developed in metaheuristic optimization, inspired by the multi-verse theory in physics [22]. Reference [23] reports results on parameter extraction at STC using two very different methods: an iterative method based on the Newton-Raphson algorithm and an analytical method based on the Lambert W function (LW). The parameters in Table 1 are extracted using the LW method. Reference [24] proposes an iterative algorithm (ITA) for extracting parameters of the 1-diode model from data provided in the datasheets by manufacturers. The method avoids solving implicit equations, thus allowing a reduction in algorithm complexity. A Wind Driven Optimization (WDO) technique is proposed in [25] as a precise method for extracting parameters of the

Table 1. Parameters of the 1-diode model reported in the referenced papers for the constituent solar cell of three commercially available PV modules: Kyocera KG200GT, RTC France, and Shell SM55

PV Module	Reference	Parameters					R^2
		I_L (A)	I_S (A)	m	R_s (Ω)	R_s (Ω)	
Kyocera KC200GT	Fathy and Rezk	8.21	$1.09.10^{-7}$	1.30	0.0039	3.48	0.947
	Ali et al.	8.25	$6.39.10^{-8}$	1.28	0.0024	2.49	0.991
	Alam et al.	8.21	$2.07.10^{-9}$	1.07	0.0064	13.80	0.939
	Ishaque et al.	8.22	$9.82.10^{-8}$	1.30	0.0042	11.10	0.981
	Wang et al.	8.21	$9.83.10^{-8}$	1.30	0.0042	10.98	0.980
	Ibrahim et al.	8.21	$9.89.10^{-8}$	1.30	0.0042	10.59	0.979
		8.24	$1.14.10^{-15}$	0.88	0.0070	2.28	0.972
	Nassar-eddine et al.	8.21	$2.15.10^{-9}$	1.07	0.0057	2.57	0.939
	Derick et al.	8.18	$4.42.10^{-7}$	1.41	0.0020	13.84	0.980
RTC France	Fathy and Rezk	0.76	$1.46.10^{-7}$	1.44	0.0380	41.10	0.978
	Ali et al.	0.76	$3.20.10^{-7}$	1.52	0.0360	59.50	0.974
	El Tayyan	0.76	$2.09.10^{-7}$	1.43	0.0400	50.00	0.935
	Alam et al.	0.76	$3.10.10^{-7}$	1.47	0.0360	52.80	0.946
	Derick et al.	0.76	$3.22.10^{-7}$	1.48	0.0367	57.75	0.967
	Xu et al.	0.76	$3.18.10^{-7}$	1.48	0.0363	53.72	0.971
Shell SM55	Alam et al.	3.45	$1.33.10^{-7}$	1.37	0.0090	12.50	0.998
	Xu et al.	3.40	$1.22.10^{-9}$	1.08	0.0124	12.66	0.993

1-diode model with fewer iterations. Six methods for extracting parameters of the 1-diode model are reviewed in Ref. [26]. Parameter values evaluated with an iterative method (IT) and a piecewise linear approximation technique of the curve are inserted into Table 1. The approach proposed in [27], based on the LW function, can extract the five parameters from experimental data or from information available in the datasheets of the cells. Reference [28] proposes a procedure based on FPA combined with a simple Nelder-Mead method and a general cooperative-based learning mechanism.

If we look at Table 1, we observe notable differences between the sets of parameters estimated by different studies for a given PV module. To verify the accuracy of the estimation, we introduced each set of parameters into Eq. (7), thus reproducing the I-V characteristic of the photovoltaic module at STC. The results reported in the papers cited in Table 1 were confirmed,

with each set of parameters accurately reproducing the measured I-V characteristic (for example, for the Kyocera KC200GT module, the coefficient of determination falls within the range $0.943 \leq R^2 \leq 0.991$) as it can be seen also in Fig. 6.

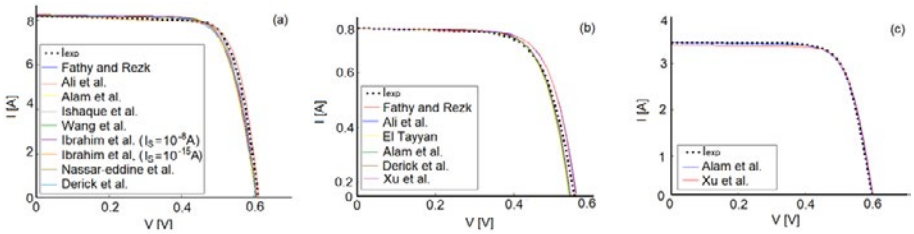


Figure 6. The I-V characteristics obtained for (a) Kyocera KC200GT, (b) RTC France, and (c) Shell SM55. [19]

The overlap of the two curves, measured and estimated, is not always perfect, likely due to the assumed measured I-V characteristic in the study. This was obtained by digitizing the I-V characteristic from the manufacturers' datasheets. The measured I-V characteristics used in the cited studies might slightly fluctuate around the generic I-V characteristic from the datasheet. Looking at the differences between the parameters in Table 1, even this reasonable overlap of the measured I-V characteristic with all estimated I-V characteristics seems unusual. For example, in the case of the Kyocera KC200GT PV module, the identified values for the saturation current fall within a range spanning several orders of magnitude 10^{-15} $A<I_S<10\text{-}10^{-7}A$, while the coefficient of determination varies within the range $0.943 \leq R^2 \leq 0.991$. It is known that the saturation current I_S of a solar cell can be experimentally measured under dark conditions [29]. Certainly, there is no guarantee that any of the numerical methods listed in Table 1 would lead to the measured value of I_S. Additionally, the ideality factor m takes values in a wide domain, with a minimum m = 0.88 (a non-physical value) and a maximum m = 1.41. Therefore, the data in Table 1 underline the fact that there are multiple sets of parameters that, when substituted into Eq. (7), accurately reproduce the measured I-V characteristic of a PV module. This observation raises a major question: What is the true set of physical parameters? Or, in other words, how can we be sure that we extract exactly the set of parameters that would result from measurements? We addressed this question extensively in [19] where some possible solutions were enounced and discussed: (1) Combining the straightforward measurement

of IS with a numerical procedure for extracting the other four parameters, (2) using the link between the common electrical specification of a PV module at STC (short-circuit current and open-circuit voltage) and the 1-diode model parameters (the diode saturation current and the diode ideality factor), and (3) replacing the 1-diode model with the two-diode model, where the diode ideality factors are defined a priori.

4. Conclusions

To model a PV system and convert solar energy into electric energy, a series of steps is required. SIMv.2 represents an excellent tool to estimate solar irradiance under clear-sky condition, the exceptional quality of the model being confirmed in an independent global-scale evaluation [4]. After testing SIMv.2 model in 12 stations located in regions with temperate and arid climate, the results showed an improvement in nRMSE compared to the initial version SIMv.1 by 37.1% for global irradiance and by 24.7% for diffuse irradiance. Even under extreme weather conditions, SIMv.2 captures the characteristics of solar irradiance better than SIMv.1. The results from [19] shed a new perspective on the 1-diode model. There are numerous approaches conducted at STC to extract the parameters of the 1-diode model from measurements. A review of the scientific literature reveals that for a specific PV module, a variety of reported parameters can be identified. What is truly remarkable is that all values are, in a certain sense, correct: generally, regardless of the value of , the reported parameter sets are capable of reproducing the measured I-V characteristics. This observation led to an empirical result: even if a parameter extraction algorithm can accurately reproduce the measured I-V characteristics of a solar cell, this does not guarantee the correct identification of the physical parameter set.

References

1. Solar Platform of the West University of Timisoara, Romania http://solar.physics.uvt.ro/srms/ (accessed April 2024).
2. AErosol RObotic NETwork. Retrieved from https://aeronet.gsfc.nasa.gov/.
3. Calinoiu D, Stefu N, Boata R, Blaga R, Pop N, Paulescu E, Sabadus A, Paulescu, M. (2018). Parametric modeling: A simple and versatile route to solar irradiance. Energy Conversion and Management, 164, 175-187.
4. Sun X, Bright JM, Gueymard CA, Bai X, Acord B, Wang P (2021). Worldwide performance assessment of 95 direct and diffuse clear-sky

irradiance models using principal component analysis. Renew Sustain Energy Rev 136: 110087.
5. Baseline Surface Radiation Network. Retrieved from https://bsrn.awi.de/.
6. Maafi A, Harrouni S (2003) Preliminary results of the fractal classification of daily solarirradiance. Sol Energy 75: 53–61.
7. Spencer W. (1971) Fourier series representation of the position of the sun. Search 2:172.
8. Stefu N, Paulescu M, Blaga R, Calinoiu D, Pop N, Boata R, et al. (2016) A theoretical framework for Angström equation. Its virtues and liabilities in solar energy estimation. Energy Convers Manage 112: 236–245.
9. Air Mass 1.5 Spectra. Available online: https://www.nrel.gov/grid/solar-resource/spectra-am1.5.html (accessed April 2024).
10. Paul S, Sohal S, Swartz C, Li DB, Bista SS, Grice CR, Yan Y, Holtz M, Li JV (2020) Effects of post-deposition CdCl2 annealing on electronic properties of CdTe solar cells. Sol. Energy 211: 938–948.
11. Nelson, J. The Physics of Solar Cells; Imperial College Press: London, UK, 2013.
12. Sharma D, Mehra R, Balwinder RB (2021) Comparative analysis of photovoltaic technologies for high efficiency solar cell design. Superlattices Microstruct 153, 106851.
13. Liao P, Zhao X, Li G, Shen Y, Wang M (2018) A New Method for Fitting Current–Voltage Curves of Planar Heterojunction Perovskite Solar Cells. Nano-Micro Lett. 10, 5.
14. Appelbaum J, Peled A (2014), Parameters extraction of solar cells – a comparative examination of three methods, Solar Energy Materials & Solar Cells 122: 164-173.
15. Mares O, Paulescu M, Badescu V (2015) A simple but accurate procedure for solving the five-parameter model. Energy Convers. Manag. 105: 139–148.
16. Fathy A, Rezk H (2017) Parameter estimation of photovoltaic system using imperialist competitive algorithm, Renewable Energy 111: 307-320.
17. Alam D, Yousri D, Eteiba M. (2016), Parameters extraction of the three diode model for the multi-crystalline solar cell/module using Moth-Flame Optimization Algorithm, Energy Conversion and Management 123: 535 – 548.

18. Abbassi R, Abbassi A, Jemli M, Chebbi S (2018), Identification of unknown parameters of solar cell models: A comprehensive overview of available approaches, Renewable and Sustainable Energy Reviews 90: 453-474.
19. Sabadus A, Paulescu M (2021) On the nature of the one-diode solar cell model parameters. Energies 14, 3974
20. Alam D, Yousri D, Eteiba M. (2016), Parameters extraction of the three diode model for the multi-crystalline solar cell/module using Moth-Flame Optimization Algorithm, Energy Conversion and Management 123: 535 – 548.
21. Ali EE, El-Hameed MA, El-Fergany AA, El-Arini MM (2016) Parameter extraction of photovoltaic generating units using multi-verse optimizer, Sustainable Energy Technologies and Assessments 17: 68-76.
22. Mirjalili S, Mirjalili SM, Hatamlou A (2016) Multi-Verse Optimizer: A nature-inspired algorithm for global optimization. Neural Comput. Appl. 27, 495–513.
23. Nassar-eddine I, Obbadi A, Errami Y, El fajri A, Agunaou M (2016), Parameter estimation of photovoltaic modules using iterative method and the Lambert W function: A comparative study, Energy Conversion and Management 119: 37 – 48.
24. Wang G, Zhao K, Shi J, Chen W, Zhang H, Yang X, Zhao Y (2017), An iterative approach for modeling photovoltaic modules without implicit equations, Applied Energy 202: 189-198.
25. Derick M, Rani C, Rajesh M, Farrag ME, Wang Y, Busawon K (2017), An improved optimization technique for estimation of solar photovoltaic parameter, Solar Enery 157: 116 – 124.
26. Ibrahim H, Anani N (2017), Evaluation of Analytical Methods for Parameters Extraction of PV modules, Energy Procedia 134: 69 – 78.
27. El Tayyan AA (2015), An approach to extract the parameters of solar cells from their illuminated I – V curves using the Lambert W function, Turkish Journal of Physics 39: 1 – 15.
28. Xu S, Wang Y (2017), Parameter estimation of photovoltaic modules using a hybrid flower pollination algorithm, Energy Conversion and Management 144: 53 – 68.
29. Erees QB, Macabebe EQB, van Dyk EE (2008) Extraction of device parameters from dark current-voltage characteristics of PV devices. Phys. Status Solidi C 5, 616–619.



***About the Author:**

Andreea Sabadus is a research assistant at the Institute for Advanced Environmental Research, West University of Timisoara. She completed her doctoral studies in 2021, specializing in the modeling of photovoltaic systems. Currently, her research focuses on estimating the output power of a PV module. She works on two main directions: forecasting solar irradiance in a given location as part of the Solar Energy Research Group, and assessing the functionality of PV systems, particularly solar cell modeling under both test and real weather conditions.

5.3. Comparative Analysis of Thermal Performance in Greenhouses: An Experimental and Numerical Study

Rodrigues Pascoal Castro*
University of Beira Interior

1. Abstract

This work presents a detailed comparative analysis of the thermal performance of greenhouses equipped with conventional and geothermal ventilation systems. The main objective is to determine which system offers greater energy efficiency and better environmental performance in sustainable agriculture contexts. Using an integrated approach of practical experiments and numerical modeling, the study evaluates temperature, humidity, air speed and energy consumption in different greenhouse operating environments.

2. Introduction

As the world faces increasing challenges such as population growth, significant climate change, and geopolitical instability exemplified by the war in Ukraine, the need for sustainable agricultural practices becomes more pressing. This study is dedicated to the comparative analysis of the thermal performance of ventilation systems in greenhouses, contrasting conventional methods with innovative geothermal solutions. The focus is to evaluate how these technologies can sustain ideal growing conditions in regions with adverse climates, while minimizing energy consumption and environmental impacts. Through experimental and numerical approaches, we seek to offer critical insights for the advancement of technologies that effectively respond to the demands of increasingly sustainable and energy-efficient agriculture.

3. Objectives

We explore four main objectives:

1. Compare the Efficiency of Air Conditioning Systems
   This objective involves comparing the thermal performance of greenhouses equipped with conventional and geothermal

ventilation systems. Through experimental methods and numerical simulations, the study seeks to identify which technology demonstrates greater efficiency in maintaining ideal plant growth conditions while minimizing energy use.

2. Contribute to Advances in Sustainable Agriculture
   The study aims to evaluate the impact of air conditioning technologies on energy consumption and the ecological footprint in greenhouses. By determining how different HVAC systems can contribute to significant reductions in resources used, the study aims to support the development of more sustainable agricultural practices.
3. Guide the Design and Operation of Greenhouses
   This objective focuses on developing practical guidelines for the design and management of greenhouses. Using data obtained from experiments and numerical simulations, the study aims to provide recommendations that improve energy efficiency and growing conditions within greenhouses, with special attention to sustainability and economic efficiency.
4. Integrate Experimental Analysis and Numerical Modeling
   The integration of numerical modeling with practical experimentation is central to this study. This objective seeks to deepen the understanding of greenhouse climate systems, validate numerical models with real experimental data, and base recommendations on greenhouse design and operation based on these findings.

4. Context and Motivation

The relevance of this study to modern agriculture is indisputable, especially in a world where sustainability and energy efficiency are unavoidable imperatives. As population growth accelerates and demand for food increases, finite natural resources are strained to the extreme, making optimizing energy consumption and improving greenhouse growing conditions key steps towards safer agricultural practices. This study responds to this critical need by exploring advanced climate control technologies that aim to not only increase agricultural productivity but also reduce the sector's ecological footprint. The integration of these issues with global sustainability objectives seeks to establish a balance between production efficiency and environmental responsibility.

Furthermore, climate change intensifies agricultural challenges, making greenhouse air conditioning even more critical to maintaining production in diverse environmental conditions. The war in Ukraine also highlights the importance of food security and the need for resilient and efficient agricultural systems capable of adapting to volatile global conditions. In this context, the study focuses on the comparison between conventional ventilation systems and geothermal heat exchangers. This straightforward analysis is vital to discern the advantages and benefits of each technology in terms of energy efficiency, operational cost and environmental impact. The geothermal heat exchanger, in particular, stands out as a promising innovation that can significantly reduce energy consumption for air conditioning, offering important potential for improving the sustainability of greenhouse agricultural exports. Therefore, this study aims to provide important insights that can guide future decisions and investments in greener and more efficient air conditioning technologies, paving the way for agriculture that is more adapted to the demands of an uncertain and challenging future.

5. Methodology

The methodology of this study is divided into two complementary approaches: experimental and numerical, providing a rigorous and comprehensive analysis of greenhouse air conditioning systems.

Experimental Approach

The experimental core of this study involves the configuration of two different greenhouses, each equipped with a different air conditioning system: one with conventional ventilation and the other with a geothermal heat exchanger. To accurately measure critical variables such as temperature, humidity, air speed and energy consumption, we use a series of instruments, including data loggers, fans specific to each system, anemometers and energy monitoring devices. The position of the thermocouples was designed to analyze the variation in air temperature along the entire length of the exchanger. Thus, starting from the EAHE input, the thermocouple (A) is at 3.20 m, (B) at 8.73 m, (C) at 14.26 m, (D) at 19.24 m and the last one (E) at 24.77 m. For the experiment, the preliminary trials were divided into two different categories, each referred to as “open loop” and “closed loop.” In the open circuit, also known as Layout 1, the ambient air was led to the

heat exchanger, being subsequently distributed through a pump and pipes to the interior of Greenhouse 1. Afterwards, the air circulated back to the environment, completing the cycle. Simultaneously, in Greenhouse 2, the pump directed air from the environment to the interior and, subsequently, from the greenhouse to the outside. Preliminary data collected during these experiments is currently under analysis to determine the effectiveness of each HVAC system implemented.



Figure 7. Numerical Modeling

In parallel to the physical experiments, numerical modeling is carried out using tools such as SketchUp to design the greenhouses, OpenStudio and EnergyPlus to simulate thermal performance, and Python to manipulate and analyze simulation data. This approach allows a detailed analysis of the internal conditions of the greenhouses, especially in terms of temperature and humidity, in addition to evaluating the impact of energy consumption of each air conditioning system. The main objective of numerical modeling is to virtually reproduce the experimental setup to validate the numerical models based on the real experimental data collected.

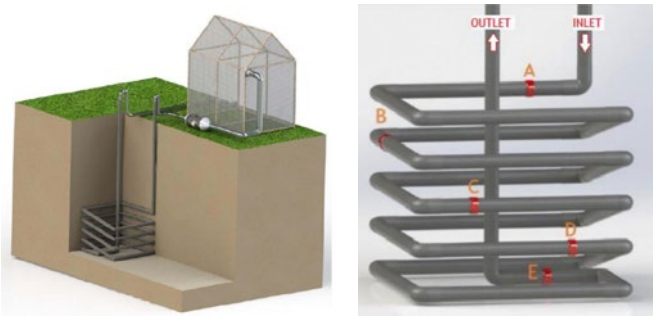


Figure 1. Greenhouse and the EAHE (Ground-to-air heat exchanger)

The combination of these two methodologies is fundamental for a holistic understanding of the performance of air conditioning systems in greenhouses, aiming to develop solutions that are both efficient and sustainable. Numerical simulations are designed to complement experimental results, providing valuable insights that will guide future improvements and innovations in greenhouse climate control.

6. Work Progress

The progress of this study to date can be described in terms of experimental data collection and development of numerical models, each offering valuable insights into the effectiveness of greenhouse HVAC systems.

6.1 Experimental Data Collected

The experiments carried out provided a consistent collection of preliminary data on variations in temperature and humidity inside the greenhouses. It has been observed that the geothermal heat exchanger keeps internal temperatures generally lower compared to the greenhouse that uses conventional ventilation and the external environment. This preliminary result highlights the potential of the geothermal exchanger to mitigate excessive heat. Furthermore, the ventilation circuits studied revealed the significant impact of air conditioning on internal conditions, indicating the need for more refined humidity control to optimize growing conditions. This fine-tuning is crucial to avoid plant water stress and maximize production efficiency.

6.2 Preliminary Insights

Preliminary data suggests that the geothermal heat exchanger not only reduces temperatures, but also promotes a more controlled microclimate, which can be extremely beneficial for certain types of crops that require stable conditions. However, the observed variability in humidity points to challenges in optimizing the growing environment, where adjustments to the air conditioning system may be necessary to maintain an ideal balance between temperature and humidity.

6.3 Numerical Modeling

In parallel with the collection of experimental data, the construction of numerical models of the greenhouses is being carried out using tools

such as SketchUp, OpenStudio and EnergyPlus. These models are being developed to replicate the observed specifications and experimental conditions. Numerical modeling serves as a crucial tool for simulating different operating scenarios and evaluating the performance of air conditioning systems under varying climatic conditions. This approach not only validates experimental data, but also offers a means of exploring future optimizations without the need for extensive physical changes to the greenhouses.

In summary, the work to date has provided substantial insights into the effectiveness of greenhouse climate control systems, with a particular focus on the potential of the geothermal heat exchanger to improve the sustainability and efficiency of modern agricultural practices. The combination of experimental and numerical analyzes promises to facilitate the development of more effective strategies for environmental management in greenhouses, aligned with long-term sustainability objectives.

7. Challenges and Solutions of this work

Challenges Faced

Throughout this work, a number of significant challenges emerged, directly impacting the accuracy and effectiveness of experimental and numerical results. Here are the main challenges identified and how they affect the study:

1. Reading External Environmental Data: Accuracy in collecting external data is crucial, as errors or inconsistencies can affect the interpretation of the effects of air conditioning systems inside greenhouses.
2. Integration of Experimental Data with Numerical Models: The complexity in aligning and integrating experimental data with numerical simulations can lead to discrepancies in model validation.
3. Equipment Calibration: Poorly calibrated equipment can generate inaccurate data, compromising the validity of experimental results and, by extension, numerical simulations.
4. Numerical Model Complexity: Highly complex numerical models can be difficult to tune and optimize, which increases the risk of errors and reduces the efficiency of simulations.

5. Choice of Climate File for Numerical Component: Inappropriate choice of climate files can result in simulations that do not adequately represent local conditions, leading to inaccurate predictions of the performance of air conditioning systems.

Solution Strategies

For each of the challenges faced, specific strategies were developed to mitigate problems and improve the reliability of the study results:

1. Enhancement in External Data Collection: Implementation of more accurate sensors and robust data collection methods to ensure the integrity of data from the external environment.
2. Improving Experimental-Numerical Integration: Refinement of data transfer processes and analysis techniques to ensure a more fluid and precise integration between experimental data and numerical models.
3. Rigorous Calibration of Equipment: Adoption of a regular calibration program for all measuring instruments, ensuring the accuracy and reliability of the data collected.
4. Simplification and Improvement of Numerical Models: Review and simplification of numerical models to facilitate adjustments and optimizations, while maintaining the precision necessary for reliable simulations.
5. Careful Selection of Climate Files: Using multiple sources and historical data to select climate files that best represent the specific conditions of the study site, improving the relevance and applicability of simulations.

These strategies are designed to overcome the challenges encountered and maximize the effectiveness of the study, thus contributing to significant advances in the understanding and implementation of more efficient and sustainable climate control systems in greenhouses.

8. Next Steps of Work

This study will continue to evolve through a series of experiments and simulations designed to expand the knowledge and application of sustainable greenhouse climate systems. Below, we detail next steps in three main areas: Future Experiments, Future Simulations, and Practical Recommendations.

Future Experiments

1. Completion of Data Collection: The initial data collection phase is approaching its end. Completing this step is crucial to ensure we have a robust set of data for further analysis.
2. Expansion of Experiments: With initial data in hand, we plan to expand the scope of experiments to include more environmental variables and test the effectiveness of different HVAC system configurations. This will allow a more comprehensive understanding of the interactions between climate variables and air conditioning systems.
3. Integrated Analysis: We will integrate data from multiple experiments for a holistic analysis. This analysis will seek to identify patterns and correlations between the variables studied, providing a more complete view of the impact of air conditioning systems on the greenhouse environment.

Future Simulations

1. Finalization of Numerical Models: The numerical models being developed will be completed, incorporating the latest data updates and parameter adjustments.
2. Model Validation: Once finalized, models will be rigorously validated against collected experimental data to ensure their accuracy and reliability.
3. Scenario Exploration: With validated models, we will explore a variety of simulation scenarios to predict the behavior of HVAC systems under different climatic and operating conditions. This will help identify the most efficient and sustainable configurations.

Practical Recommendations

Based on the results of experiments and simulations, we will develop practical recommendations for the design, implementation and operation of greenhouse climate systems. These recommendations will aim to maximize the energy efficiency, sustainability and agronomic performance of greenhouses, facilitating the adoption of greener and more effective practices in modern agriculture.

These next steps are essential to deepen our understanding and optimization of greenhouse climate control systems, aligning advanced technology with emerging environmental sustainability needs in the agricultural sector.

9. Expected Impact of this Work

This study is positioned to make significant contributions to both science and technology and sustainable agriculture, having a profound and lasting impact on these areas.

9.1 Contributions to Science and Technology

Advancement in Knowledge about Greenhouse Air Conditioning: This work aims to substantially expand the current understanding of greenhouse air conditioning, exploring both conventional technologies and innovations such as geothermal systems. Deepening this knowledge is essential to improve existing practices and encourage the development of new solutions.

Development of Advanced Numerical Models: The creation of detailed and accurate numerical models that can simulate the thermal behavior of greenhouses under various climatic conditions represents a significant advance. These models make it easier to predict and improve climate conditions, serving as crucial tools for researchers and engineers in the field.

9.2 Benefits for Sustainable Agriculture

Energy Efficiency: One of the main goals of this study is to demonstrate how efficient HVAC systems can reduce energy consumption in greenhouses. The implementation of these technologies not only reduces operational costs, but also contributes to reducing the carbon footprint of agriculture.

Promoting Sustainable Agricultural Practices: By developing and validating HVAC systems that use less energy and resources, this study promotes more sustainable practices. This is crucial to ensuring the long-term viability of agriculture, especially in the face of growing environmental challenges.

Climate Resilience: By introducing technologies that can effectively adjust and control the greenhouse environment, this work contributes to the climate resilience of agricultural operations. More effective and adaptable climate control systems allow farmers to maintain production even under extreme and variable weather conditions, essential for global food security.

Together, these impacts represent significant advances both in the technical-scientific field and in practical application in agriculture, supporting the transition to more sustainable and efficient practices. This

study not only promotes a deeper understanding of greenhouse HVAC systems, but also offers concrete solutions to address current and future environmental challenges.

Conclusion

This study reinforces the importance of continued innovation in climate control technologies to address the challenges of modern agriculture. The insights obtained are crucial for developing more sustainable and efficient agricultural practices, aligning energy efficiency with the demands of a constantly evolving sector.



***About the Author:**

Rodrigues Pascoal Castro is a PhD student at the University of Beira Interior, specializing in sustainable technologies and energy efficiency in agriculture. With a background in mechanical engineering, Castro has a deep interest in innovative solutions to environmental problems. His work on geothermal greenhouses has gained recognition for the practical application of climate control theories in real growing conditions, aiming for sustainability and reducing energy consumption. This study reflects its commitment to advancing applied science in sustainable agriculture.

PART II. DISCUSSION TOPICS IN RENEWABLE ENERGIES ROUND-TABLE

Moderator: Luís Carlos Carvalho Pires

Round-table members: Frédéric Marias, Vanderlei Cruz, Davide Fonseca, Marius Stef

5.4. Notes from the round-table moderator

Luís Carlos Carvalho Pires*

University of Beira Interior | Faculty of Engineering

C-MAST - Center for Mechanical and Aerospace Science and Technologies

Researchers' Presentations

The researchers' presentations section started with the presentations of María Paz Comech Morenc, from the University of Zaragoza, under the title Research Challenges for renewable energies. María Paz made an overview of the energy situation of the Autonomous Community of Aragon and reviewed the major challenges and opportunities for that region, focusing on rural regions with lower population density.

It followed the presentation of Andreea Sabadus, from the West University of Timisoara, with the title of Modeling and measurements of solar radiation at West University of Timisoara. Andreea addressed the importance of solar radiation forecasting and presented experimental and numerical results of solar radiation forecasting work carried out at the West University of Timisoara.

The researchers' presentations section ended with the presentations of Rodrigues Pascoal Castro, from the University of Beira Interior, with the title of Comparative Analysis of Thermal Performance in Greenhouses: An Experimental and Numerical Study. Rodrigues presented his PhD work, which is in progress, in which he will study the application of passive techniques in the heating and cooling of agricultural greenhouses.

Debate Session | Round-Table

Round table on renewable energies was like a conversation between friends who wanted to learn which each other's. We discussed major questions about renewable energies, from political to technological.

Renewable energies are sources of clean, inexhaustible, and increasingly competitive energy. Unlike fossil fuels, they are characterized by their diversity, abundance, and geographical spread. And, of course, they are carbon-free. Their costs are also falling at a sustainable rate while the general costs for fossil fuels are in the opposite direction.

Growth in clean energies is unstoppable.

Among others, we discussed the importance of energy storage, CO2 emission taxes and CO2 capture and storage to reach net zero greenhouse gas emissions, by 2050, in Europe and in the rest of the World.

Being consensual that energy storage is key to secure constant renewable energy supply, we looked for the different storage options. Without denying the relevance of electric battery storage, we pointed the importance of other forms of storage, like hydrogen, thermal, thermochemical, among others.

We agreed that the best energy options for the UNITA territories should involve mixed solutions, different for each territory. It would be good to have a tool that could be used to help politics to choose the best solution for each case. That tool needs to be an interdisciplinary tool, from engineering to sociology, that could be proposed by the academies. Maybe it could be done in the UNITA environment! That is one of the things UNITA universities can do to help achieving climate goals in their territories.

We talked about the transport sector, that includes, heavy-duty trucks, aviation, and maritime shipping. Can it be electric? With batteries or hydrogen? Can biofuels and eFuels be part of the solution?

We also discussed what are the major problems and best solutions concerning the renewable energy impact on grid reliability and power quality.

We were not afraid to discuss the nuclear energy option. Can we achieve climate goals without nuclear energy? Being a carbon-free energy source, why isn't nuclear energy more widely used? Are the problems technical or political? Of course, it needs to be safer, cheaper, and faster to build. Could the answer lie in Small Module Reactors? If it is a problem to defend few nuclear plants, wouldn't it be an enormous s problem to defend widely spread Small Module Reactors?

At the end, we talked about how the world geopolitical crisis could affect the energy transition and how the international fragmentation can be set aside from major common climate interest. For example, in Germany, because of Russia's invasion of Ukraine, nuclear power option is being discussed again. Portugal and Spain, who had shut down their coal plants few months before the invasion, saw their electricity prices rise significantly.

It was, really, a good talk about renewable energies.



***About the Author:**

Luís Pires was born in Lubango, Angola. He graduated in Electromechanical Engineering in 1996 and obtained his PhD in Mechanical Engineering in 2011, in both cases, from University of Beira Interior, Covilhã, Portugal.

Luís Pires is an Assistant Professor and a researcher in the Engineering Faculty of the University of Beira Interior. He teaches applied thermodynamics, renewable energies, and medical devices technologies. The main scientific areas in which he does research are thermal processes, passive heating and cooling, hybrid solar modules (PV-TEG-T), earth-to-air heat exchangers and medical infrared thermography applications.

5.5. Proposal for development of a Methodology to support renewable energies use for isolated territories

Frédéric Marias*
University of Pau and Pays de l'Adour - LATEP - Laboratory of thermal science, energetics and chemical engineering

UNITA is an European alliance for which the universities that make it up are all closed to mountain and rural territories. For such lands, it is common that small villages or groups of houses, are badly connected to any energy network like electricity or gas. Hence, these territories might be thought as isolated from the energy point of view, despite they might benefit from important local primary resources (solar, biomass, wind, hydropower, geothermy).

Conversion technologies of these primary resources into electricity, heat, cold or gas are already available and might be installed at the domestic scale as it is already the case for solar panels providing electricity and/or heat, wind turbines, and biomass boilers (even very rudimentary as it is the case for open or cheminey fire). Such "individual solutions" might be very expensive and are most of the time not completely satisfactory without storage as the primary resource on which they belong is transient.

There is hence a need to mutualize these energy conversion systems, at a scale that depends on the size of the "energy community" that would be created by grouping housings that would like to enter such communities. However, the design of such energy transformation and supply system depends of a lot of criteria (number of people in the community, distance between houses, solar irradiation, wind velocity, biomass abundance and quality, final form of energy required, investment, operation, maintenance, social acceptance, management…) which prevents any local political representative from being able to provide a complete and affordable solution.

With several researchers daily working on the design and performance of such energy conversion units, on life cycle assessment, the UNITA R&I hub devoted to renewable energies could be the right place to start addressing such studies by providing assistance to our territories, solving such questioning. This idea was proposed to the group of researchers that attend the Part 2 of the workshop devoted to renewable energy. Indeed, could we all together start by thinking about a special village in each of our territories, and for which such energy transformation and supply unit would be designed, given the national policies, subsidies and specificities of each village considered? This would create a kind of "comparative test" on which the R&I Hub could work together, sharing experience and good practices, and start developing a general methodology, that could be grown and finally used in our territories to reach the goal for which it is being built: providing an objective tool to develop local energy communities relying on renewable resources and delivering high quality energy at low environmental cost and affordable.

Possible technologies that might be considered in such study could be :

PV Solar Panels
T Solar Panels
PVT Solar Panels
Electrical panels
Heat Storage (latent, sensible, adsorption units)
Electricity storage (batteries)
Electrolyser
Anaerobic digestion unit
Gas storage
Gas motors
Biomass boilers
Wind turbines (vertical, horizontal)
Air compression unit
…

This proposal received positive feed-back during the roundtable even-though the final objective would require an important amount of work and data collection to be able to provide the best decision-making help tool given the available conversion technologies and very wide geographical characteristics of the above-mentioned energy communities.



***About the Author:**

Prof. Frederic Marias completed his M.Sc degree in 1995 at the University of Pau and Pays de l'Adour in the department of Chemical Engineering (Ecole Nationale Supérieure en Génie des Technologies Industrielles). He began his PhD Thesis in 1996 on the topic of the modelling of Fluidized bed Incineration Process. He obtained his PhD by the end of 1999 in energetic and transfer. Then, he joined the Imperial College of Science Technology and Medicine in London at the Centre for Process System Engineering for a post-doctoral position. He is currently Full Professor in Chemical Engineering at the University of Pau and Pays de l'Adour. Current field of research includes modelling of reactors devoted to waste and biomass thermal treatment and mathematical dynamic optimization of Multi Energy platforms. Up to now, he is the author of 70 publications in international journals and 50 communications. He is also in charge of international affairs at the Chemical an Energy Engineering department at the University of Pau, and coordinator of research and innovation activities in European University UNITA.

ORCID : https://orcid.org/0000-0001-6295-4326

5.6. Assessment of wind resources with a focus on micro-generation applied on farmland in Portugal inland

Vanderlei Cruz*
Polytechnic University of Castelo Branco (IPCB)

Abstract: Since immemorial time, wind energy has been exploited. Taking advantage of the progress of technology, it has become possible to produce electricity through wind turbines in windy locations, even in the most remote places. In various parts of the world, especially in places with favorable conditions, it has become evident that such alternative energy corresponds to an extremely interesting choice. The main focus is on analyze the direction and intensity of winds in the Beira Baixa region, expanding that to the possibility of using wind turbines in micro generation, next to the rural population and the villages. But not neglecting the possibilities of integration with other renewable energy sources, through cogeneration, such as solar and hydro.
keywords: Energy Sustainability; Portugal and Wind Energy; Renewable Sources Integration; Sustainable Agriculture; Wind Energy

1. Introduction

Wind energy, alongside photovoltaics, has shown significant growth in the past 25 years and is a critical component in the global energy transition. Despite its potential, wind energy faces challenges related to predictability, which can lead to deviations in power supply and increased costs. Accurately characterizing wind patterns is crucial for economic feasibility analyses, especially in rural areas where connecting to the electricity grid is often cost-prohibitive. This study focuses on analyzing wind resources in the Beira Baixa region to explore the potential for small-scale wind energy production, particularly for residential and rural self-consumption.

The primary goal is to assess the wind potential focusing on the feasibility of small-scale wind turbine installations for rural and domestic

use. Digital modeling is used to identify the best locations within the study area for installing wind turbines, based on wind speed and direction data.

2. Study Area and Methods

The study area includes the municipalities of Penamacor, Idanha-a-Nova, Castelo Branco, Oleiros, Proença-a-Nova, and Vila Velha de Rodão, which form the Intermunicipal Community of Beira Baixa (CIMBB). The study uses data from the Portuguese Institute for Sea and Atmosphere (IPMA) and the National Water Resources Information Service (SNIRH) to analyze wind patterns.

Spatial data was geoprocessed using the ArcGIS tool (ESRI), using Digital elevation model (DEM) layers and land use data. The geostatistical methodology selected for processing wind speed data at different heights was co-kriging, between the point data and DEM (spatial resolution of 25 m x 25 m).



Fig. 1 - Location of the study area:dot (weather stations), polygon (CIMBB)

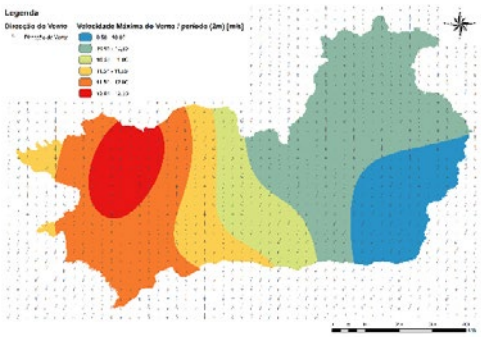


Fig. 2 - Maximum wind speed (average 2001-2021)

3. Wind Resource Assessment

The study evaluates wind speeds at heights of 2, 5, 10, and 20 meters. It finds that the height of 20 meters is most auspicious for energy generation, with potential production ranging from 200 kWh/month in less windy areas to near 5000 kWh/month in more favorable locations like Oleiros. This data is crucial for determining the optimal locations for wind turbine installations and selecting the best technology to maximize energy production.

The wind intensity at 5, 10, and 20 meters height (Equation1 and Table1).

$$V_H = \vec{v} \cdot \left(\frac{H}{H_a}\right)^{\alpha} \quad (1)$$

where: $V_H[m \cdot s^{-1}]$ wind speed at the calculated height; $\vec{v}[m \cdot s^{-1}$ wind speed measured by the anemometer; H[m] height where the wind turbine it will be installed; H_a [m] anemometer height; α wind shear exponent.

Table1 - Wind speed (V_H)

2001-20021	H[2m]	H[5m]	H[10m]	H[20m]
V_H[m.s^{-1}]Min.	0.96	1.15	1.32	1.52
VH[m.s^{-1}]Max.	2.70	3.24	3.73	4.28

The wind power (Equation2 and Table2)

$$P_w = \frac{1}{2} \cdot \rho \cdot A \cdot v^3 \Leftrightarrow P_w = \frac{1}{2} \cdot \rho \cdot \left(\frac{\pi \cdot r^2}{2}\right) \cdot v^3 \quad (2)$$

where: $P_w[W]$ calculated wind power; ρ air density 1.204[kg·m^{-3}] (NTP: T=20[°C]; P=1[atm]); A[m^2] air section area passing through the turbine's propellers; $v[m \cdot s\text{-}1]$ wind speed; $r[m]$ radius of the turbine propellers.

Table2 - Wind Power(P_w)

2001-20021	H[2m]	H[5m]	H[10m]	H[20m]
r[m]	0,5	3,75	7,5	15
Pw[W]Min.	0,21	20,39	123,60	749,40
Pw[W]Max.	4,65	453,56	2749,87	16672,10

The wind energy (Equation3 and Table3)

$$E_w = P_w \cdot CF \cdot 8.76 \quad (3)$$

where: E_w [(*kW·h/year*] calculated potential energy; P*w* [*W*] calculated wind power; *CF* wind turbine capacity factor (40% by default); 8.76 number of hours in 1 year divided by 1000.

Table 3 - Wind Energy(E_w)

2001-20021	H[2m]	H[5m]	H[10m]	H[20m]
Ew[kWh/year]Min.	0,73	71,44	433,11	2625,89
Ew[kWh/year]Max.	16,30	1589,27	9635,55	58419,02

4. Energy Production and Cogeneration Potential

The analysis emphasizes the importance of cogeneration, combining wind and solar energy to enhance overall energy production. Given that wind speeds are not constant, integrating solar panels with wind turbines can provide a more stable energy supply. The study also highlights the potential for battery storage systems to store excess energy produced during peak wind periods for use during calmer periods.

5. Final Remarks

The document concludes that up to 20 meters, significantly increase energy production due to improved wind speeds. However, the costs associated with higher capacity and technologically advanced equipment are also higher. Despite this, the integration of micro-generation with cogeneration and the development of decentralized energy management solutions presents a promising future for sustainable energy in Beira Baixa. Public policies and incentives, such as specific credit lines for small-scale electricity production, could further enhance the viability of these renewable energy projects.

6. Conclusions

The assessment demonstrates that wind energy, when combined with other renewable sources like solar energy, can significantly contribute to the energy needs of rural areas in Beira Baixa. This approach not only

supports sustainable agriculture but also promotes energy independence and economic feasibility in regions with limited access to the electricity grid.

By providing a detailed wind resource assessment and exploring the integration of wind and solar energy, the study offers valuable insights for the development of renewable energy projects aimed at micro-generation in rural settings. The findings underscore the potential for renewable energy to play a pivotal role in the sustainable development of the Beira Baixa region.

Annex 1

Co-krigagem			
2m	Predicted		0,0533705013512923x + 1,23615217992149
	Error		-0,946629498648708x + 1,23615217992150
	Standardized Error		-2,66210114037576x + 3,47787206641089
	Optimize	Mean	-0,00882332035360645
		Mean Standardized	-0,01904293046647680
		Root-Mean-Square	0,35881160467155800
		Root-Mean-Square Standardized	1,00463936880986000
		Average Standard Error	0,36054882165521300
5m	Predicted		0,0534555658184429x + 1,48466794827222
	Error		-0,946544434181557x + 1,48466794827222
	Standardized Error		-2,21619302148566x + 3,47768626541596
	Optimize	Mean	-0,01053709494220260
		Root-Mean-Square	0,43095765777011200
		Mean Standardized	-0,01892540941433770
		Root-Mean-Square Standardized	1,00462835392518000
		Average Standard Error	0,43305406663533600
10m	Predicted		0,0533804104759775x + 1,70556878790329
	Error		-0,946619589524023x + 1,70556878790329
	Standardized Error		-1,92947436175227x + 3,47798059033243
	Optimize	Mean	-0,01208990183075200
		Root-Mean-Square	0,49500070600596100
		Mean Standardized	-0,01890435233873240
		Root-Mean-Square Standardized	1,00456374836261000
		Average Standard Error	0,49744580810175800
20m	Predicted		0,0533843058107503x + 1,95922196492210
	Error		-0,946615694189249x + 1,95922196492210
	Standardized Error		-1,67967483213759x + 3,47799931278687
	Optimize	Mean	-0,01389270429096320
		Root-Mean-Square	0,56863885973478200
		Mean Standardized	-0,01890936698537470
		Root-Mean-Square Standardized	1,00460068709759000
		Average Standard Error	0,57142249087597800

References

1. A. Silva, "Optimização de Recursos Hídricos em Coordenação com a Produção Eólica: Decisão para Lances Conjuntos no Mercado do Dia Seguinte", Doctoral dissertation, Covilhã 2019
2. G. Kariniotakis et al., "Next generation forecasting tools for the optimal management of wind generation", in Proc. Int. Conf. Probabilistic Methods Applied to Power Systems, Jun. 2006, pp. 1–6.
3. I. Sánchez, "Short-term prediction of wind energy production", Int. J. Forecast., vol. 22, no. 1, pp. 43–56, Jan. 2006.
4. A. J. Wu, X. Guan, X. Zhou, and Y. Zhou, "Estimation and characteristic analysis of aggregated generation of geographically distributed wind farms", in Proc. 2011 IEEE Power Engineering Society General Meeting, Jul. 2011, pp. 1–6.
5. D. Lew, M. Milligan, G. Jordan, and R. Piwko, "The value of wind power forecasting", in Proc. 91st Amer. Meteorological Society Ann. Meeting, 2nd Conf. Weather, Climate and New Energy Economy, Washington, DC, Jan. 2011.
6. C. Potter, M. Negnevitsky, and K. Jacka, "Short-term wind forecasting application using an Adaptive Neural-Fuzzy Inference System (ANFIS)", Artificial Intelligence in Science and Technology, 2004, pp. 175-180.
7. M. S. Roulston, D. T. Kaplan, J. Hardenberg, and L. A. Smith, "Using medium-range weather forecasts to improve the value of wind energy production", Renew. Energy, vol. 28, pp. 585–602, 2003.
8. J. B. Bremnes, "Probabilistic wind power forecasts using local quantile regression", Wind Energy, vol. 7, no. 1, pp. 47–54, Jan.–Mar. 2004.
9. J. Juban, N. Siebert, and G. N. Kariniotakis, "Probabilistic short-term wind power forecasting for the optimal management of wind generation", in In Proc. of the IEEE PowerTech Conference, Lausanne, Switzerland, July 2007.
10. H. A. Nielsen, H. Madsen, and T. S. Nielsen, "Using quantile regression to extend an existing wind power forecasting system with probabilistic forecasts", Wind Energy, vol. 9, no. 1-2, pp. 95–108, 2006.
11. Instituto Português do Mar e da Atmosfera, "IPMA", [Online]. Available: https://www.ipma.pt/bin/file.data/climate-normal/cn_71-00_CASTELO_BRANCO.pdf. [Accessed on 08 10 2023].
12. Instituto Português do Mar e da Atmosfera, "IPMA", [Online]. Available: https://www.ipma.pt/bin/file.data/climate-normal/cn_81-10_CASTELO_BRANCO.pdf. [Accessed on 08 10 2023].

13. Instituto Nacional de Estatística, “ine.pt”, [Online]. Available: https://www.ine.pt/. [Accessed on 08 10 2023].
14. Sistema Nacional de Informação de Recursos Hídricos (SNIRH), “snirh.pt”, [Online]. Available: https://snirh.apambiente.pt/. [Accessed on 08 10 2023].
15. P. D. A. J. Cerejo da Silva, Energia Eólica - O Vento, 2021. Avaliação do Recurso Eólico na Região da Beira Baixa com base nas Estações Meteorológicas do SNIRH 31
16. Pennsylvania State University - College of Earth and Mineral Sciences, “https://www.eeducation.psu.edu”, [Online]. Available: https://www.e-education.psu.edu/emsc297/node/649. [Accessed on 08 10 2023].
17. I'mNovation-hub, “https://www.imnovation-hub.com”, [Online]. Available: https://www.imnovation-hub.com/energy/new-generatiom-wind-turbines-photovoltaicpanels/?_adin=02021864894. [Accessed on 08 10 2023].



***About the Author:**

Vanderlei Cruz is a Renewable Energy Engineering graduate from Escola Superior de Tecnologia - IPCB, Portugal, with a robust foundation in continuous improvement and integration of renewable energy sources. His academic training is complemented by extensive practical experience as an electronics technician and production chief. Cruz has a history of professional engagements, including roles at Ericsson Gestão e Serviços de Telecomunicações Ltda. and General Motors do Brasil Ltda., where he honed skills in organizational management, process improvement, and problem-solving. Cruz's educational background is diverse, with qualifications as an Automation Industrial Computer Technician from SENAI and an Electronics Technician from Fundação Escola Técnica Liberato Salzano Vieira da Cunha. His academic pursuits culminated in a Bachelor's degree in Renewable Energies Engineering, where he developed expertise in assessing the environmental viability of renewable energy projects,

optimizing resource use, and implementing advanced automation and control systems. In 2023, Cruz conducted research on wind resources in the Beira Baixa region, leveraging meteorological data to evaluate microgeneration potential. He is also active in community service, participating in the Associação de Apoio Quatro Corações, where he contributes to daily meal distributions and seasonal activities as Santa Claus.

Cruz's multilingual proficiency includes English (B2), Spanish (B1), and German (A2), reflecting his ability to engage in diverse professional environments. His commitment to sustainability and technical innovation positions him as a valuable contributor to the field of renewable energy engineering.

5.7. Assessment of renewable energy potential in UNITA territories: An initial reflection

Davide S. B. Fonseca*
University of Beira Interior - CISE – Electromechatronic Systems Research Centre

For the PART II of the Workshop in Renewable Energies, participants at the round table discussed the following topics:

1. Is it possible to achieve net zero greenhouse gas emissions by 2050 in Europe and in the rest of the World?

Concerning the goal of net zero greenhouse gas emissions by 2050 in Europe, this can be achieved as long as all possible energy sources that do not emit greenhouse gases are explored.

It is particularly important to consider the transport sector and the impact of the transition to an all-electric transport system on the electricity grid (Production, transport and distribution).

It is my opinion that, at the moment, this transition is not possible without resorting to the use of nuclear electrical energy.

As a result, and considering the radioactive decay time of nuclear waste, it is important to evaluate the possibilities of using the radiation released in the production of electrical energy.

2. What are the best energy options for the UNITA territories?

UNITA territories present especially favorable conditions for the production of renewable electrical energy. Its location close to mountain systems guarantees an abundance of water and significant altitude differences for the production of hydroelectric energy.

Additionally, a low-density territory represents a lower energy demand, and an availability of large areas for the installation of PVs, always allowing agricultural use, simultaneously. Note that the capture of carbon, based on certain agricultural crops, and the use of bio-fuels cannot fail to be considered.

3. Can renewable energies help in the fight against energy poverty?

It can, in the sense that a more spread generation system, with multiple players also spread the benefits. It is important to consider the impact of the public policies for the increase energy efficiency of the buildings. If the family house needs less energy to be properly climatized, energy poverty will decrease.

4. Can renewable energies be affordable in current cost living scenario?

They must be. If we what to have social peace, access to energy must remain affordable. To have a future energy must become renewable.

5. What can UNITA universities do in their territories to help achieve climate goals?

UNITA universities are important players in the regional and national social tissue. It is of utmost importance that universities can help decision makers in the processes and, simultaneously continue to develop innovative solutions to extend the efficiency of the renewable energy conversion systems.

6. Was there an impact of Russia's invasion of Ukraine on the European energy transition?

To answer this question, the answer is both yes and no.

Yes, as it made the EU's need for energy self-sufficiency clearer and thus have greater control and energy security.

No, insofar as the war effort and Ukraine's financial support needs diverted previously allocated funds and the focus of public opinion from this issue.



*About the Author:

Davide S. B. Fonseca (Member, IEEE) was born in Castelo Branco, Portugal on December 23, 1972. He received the E. E. Diploma in 1996, from the University of Coimbra, Coimbra, Portugal and the PhD on E. E. in 2008, from the University of Beira Interior, Covilhã, Portugal.

He has been with the University of Beira Interior since 1997, where he is currently an Assistant Professor in the Department of Electromechanical Engineering,

Course Director of the MSc in Electromechanical Engineering, and the Director of the Electrical Machines and Power Electronics Laboratory. He is also Member of CISE – Electromechatronic Systems Research Centre. His research interests are focused on fault analysis and fault diagnosis in electric drives and renewable energy systems.

5.8. Research challenges in renewable energy across UNITA territories and beyond

Marius Stef*
West University of Timisoara

In the frame of debate on the future of global and regional energy, several themes were addressed to examine the perspectives and challenges associated with the transition to renewable and sustainable energy sources. Among these, a focal point was the possibility of achieving the goal of net zero greenhouse gas emissions by 2050, both in Europe and the rest of the world. Romania has adopted a series of important measures and strategies covering a wide range of economic and social domains. These include promoting renewable energy and energy efficiency, investing in clean and innovative technologies, encouraging the use of public transport and electric vehicles, as well as implementing policies and regulations aimed at reducing emissions in industrial and agricultural sectors. A key element of this approach is the National Plan for Reducing Greenhouse Gas Emissions (PNIESC), which sets clear objectives and specific measures for each sector of the economy. This plan provides a clear direction and framework for action for public authorities, the private sector, and civil society in the joint effort to reduce carbon emissions. Additionally, Romania is committed to international collaborations and exchange of experience with other countries and organizations to learn from best practices and align with the latest developments and standards in clean and sustainable energy.

Furthermore, aspects regarding energy strategies for UNITA territories and the role of renewable energies in combating energy poverty were discussed. In UNITA territories, energy strategies begin with assessing the natural wealth of each region: the sun, wind, powerful flowing rivers, and abundant biomass in some regions. These represent an immense source of renewable energy capable of transforming the lives of local communities. Energy strategies are designed not only to bring light and

warmth into people's homes but also to lift communities out of poverty and isolation. By increasing accessibility to energy, new opportunities for economic and social development are opened up: from creating jobs in the renewable energy industry to improving access to education, health, and communications. In this context, education and awareness are key to transformation. Communities are actively involved in the energy transition process, learning about the benefits of renewable energies and how to use them efficiently. Empowering these communities not only gives them energy autonomy and independence but also provides them with prospects for a better future. Collaboration is the key element in achieving success in reaching the goals. Through close partnerships between local authorities, the private sector, and non-governmental organizations, strong synergies are created, and obstacles are overcome. Funding, technical expertise, and community support intertwine to make renewable energy projects possible.

In addition to assessing the feasibility and financial sustainability of these options, the impact they can have in the current cost of living context has been scrutinized. Furthermore, the potential of UNITA universities to act as catalysts in efforts to achieve climate goals in their territories through research, education, and community involvement has been discussed.

Another important topic addressed at the roundtable focused on the current geopolitical context, with a specific question regarding the influence of Russia's invasion of Ukraine on the European energy transition. This discussion raised issues related to energy security and regional independence in the face of such international events. Romania's energy infrastructure, especially regarding nuclear energy, represents a strategic pillar of the country's energy security and independence. In the context of geopolitical changes and uncertainty in energy supply, it is crucial to develop and strengthen our capacities in the field of nuclear energy. The establishment of a National School of Nuclear Energy (SNEN) in Romania has been an important step in this direction. This school provides a platform for the development and promotion of local expertise in the field of nuclear energy, preparing a new generation of professionals and researchers in this vital domain. By enhancing our research, education, and training capacities in the field of nuclear energy, Romania could consolidate its position as a significant player in the European and global energy landscape. SNEN contributes to increasing the national level of expertise and ensures that our country is prepared to face future challenges and opportunities in this

critical field. Moreover, SNEN has the mission to stimulate innovation and research in the field of nuclear energy, opening up new possibilities for the development of advanced technologies and sustainable solutions for energy production.

Additionally, the potential of UNITA universities to engage in research on increasing energy efficiency in the photovoltaic industry was proposed for debate. It was noted that within the UNITA alliance, there are concerns about obtaining new advanced materials that contribute to increasing the efficiency of solar energy conversion. The crystal growth group at the Faculty of Physics of the West University of Timișoara is concerned with identifying advanced materials that extend, through up-conversion phenomena, the absorption domain of the radiation used in electric energy conversion.

Overall, the discussions provided a broad and complex perspective on the challenges and opportunities in the field of renewable energy, emphasizing the need for holistic and collaborative approaches to address climate and energy issues in a sustainable and efficient manner.

***About the Author:**



Dr. Marius Stef is an associate professor at the Faculty of Physics, West University of Timișoara, teaching courses such as Fundamentals of Spectroscopy and Lasers, Defects in Crystals, IR and UV-VIS Spectroscopy for Biomedical Applications, Optical Spectroscopy of Advanced Materials, and conducting research activities in the field of growth and characterization of fluorite crystals doped with rare earth ions for laser and photovoltaic applications. He has been involved in many national and European projects, both educational and research-oriented. Currently, he serves as the vice-dean of the Faculty of Physics, with responsibilities in coordinating quality assurance activities, monitoring the educational process, and student relations. Additionally, he oversees the development of the faculty's research plan. For the past three years, he has been the president of the Timișoara Branch of the Romanian Society of Physics, actively involved in strengthening

the physics community in western Romania, with the mission of bringing together physics teachers from both pre-university and university environments, researchers from universities or research institutes, specialized physicists, as well as any other category of physicists. He has published multiple scientific papers and books/chapters in books and has participated in numerous national and international conferences.