

## D2.1 1<sup>st</sup> report on twinning and networking activities

**Reporting period: 1.10.2022-30.09.2023**

Due date of deliverable	M13
Actual submission date	M14
Organisation name of lead beneficiary for this deliverable	TU/e
Dissemination Level	PU
Start date of project	1.10.2022
Duration	36 months

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Version:	Version 1

## Contents

1. HISTORY OF CHANGES .....	3
2. ABSTRACT .....	4
3. ACTIVITIES CARRIED OUT DURING THE REPORTING PERIOD .....	5
4. DEVIATIONS FROM THE WORKPLAN .....	8
5. ANNEX (ACTIVITY REPORTS) .....	8
<b>Research workgroup RS1 (RWG1): .....</b>	<b>8</b>
<b>Research workgroup RS2 (RWG2): .....</b>	<b>10</b>
<b>Research workgroup RS3 (RWG3): .....</b>	<b>11</b>
<b>Research workgroup RS4 (RWG4): .....</b>	<b>14</b>

## 1. HISTORY OF CHANGES

No.	Chapter	Change	Page
1.			

## 2. ABSTRACT

In this first period, the general structure of the DITARTIS project was introduced among all members. Research workgroups have been organized for the different subjects among the partners and members. Specific group leaders were nominated for each work group (total 4) who coordinated the activities within each research work group. All 4 group activities have been reported in separated documents. These documents summarize the exploratory meetings (face-to-face and online), where research subjects have been discussed, interests and the objective of the group as part of the DITARTIS were defined.

### 3. ACTIVITIES CARRIED OUT DURING THE REPORTING PERIOD

In this period of the project, we have built-up 4 research workgroups (RWG) for 2 different research subjects (RS) and selected research workgroup leaders to coordinate the activities in each group. The young researchers (mostly doctoral candidates and early research fellows) are members of these research workgroups. The overview is given in Figure 1.

The member list is open during the project for new researchers to join on the topics.

Research topic	Research subject	Research workgroup leaders	Research workgroup members
R1. Digital transformation for green energy transition;	RS1. Flexible and adaptable AI & digital solutions for renewable-based electrical energy sources, storage, and smart household and building equipment and devices integration in smart building, houses and nanogrids;	<a href="#">Ioana Gros</a> (UTC) <a href="#">Caio Osorio</a> (TY) <a href="#">Xiaoshu Lu</a> (UV) <a href="#">Claudiu Oprea</a> (UTC)	<a href="#">Vahid Shahbazbegian</a> (UV) <a href="#">Mahoor Ebrahimi</a> (UV) <a href="#">Farhad Zandrazavi</a> (UV)
	RS2. AI-based demand side management (DSM) architecture based on virtual energy community and living labs in compliance with the national and European regulations and markets;	<a href="#">Augustin Pop</a> (UTC) <a href="#">Miadreza Shafiekhah</a> (UV)	<a href="#">Razvan Bocu</a> (SISW) <a href="#">Mahoor Ebrahimi</a> (UV) <a href="#">Sahar Sevedbarhagh</a> (UV) <a href="#">Ahm Shamsuzzoha</a> (UV)
R2. AI and digital solutions for EMS and PS	RS3. AI-based electrical machines and drives (design, analysis, control, testing)	<a href="#">Mircea Ruba</a> (UTC) <a href="#">Esin Ilhan Caarls</a> (TU/e)	<a href="#">Arpad Kerestely</a> (SISW) <a href="#">Alexandra Baicoianu</a> (SISW) <a href="#">Daniela Sasu</a> (SISW) <a href="#">Mitrofan Curti</a> (TU/e) <a href="#">Marko Merdzan</a> (TU/e) <a href="#">Hande Bayazit</a> (TU/e) <a href="#">Abishek Chandra</a> (TU/e) <a href="#">Razvan Inte</a> (UTC) <a href="#">Cristina Adascalitei</a> (UTC)
	RS4. Data driven condition monitoring and predictive maintenance in EMS	<a href="#">Sorin Cosman</a> (UTC) <a href="#">Jose Antonino-Daviu</a> (UPV) <a href="#">Mazaher Karimi</a> (UV)	<a href="#">Razvan Bocu</a> (SISW) <a href="#">Alexandra Baicoianu</a> (SISW) <a href="#">Daniela Sasu</a> (SISW) <a href="#">Meysam Pashaei</a> (UV) <a href="#">Claudiu Oprea</a> (UTC)

Figure 1: Overview of research workgroups, their subjects and members.

#### Research workgroups exploratory meetings:

All 4 research work groups (RWG) have individually organized their exploratory meetings.

Related exploratory meetings are reported below under specific RWG. Please see the specific activity report for the details in the Annex.

#### - RWG1:

Members introduced each other field of interest. Researchers focused on their research domain/activities and research directions, whereas industrial parties (Typhoon hil) presented an overview of their equipment and technical solutions for testing control strategies, AI algorithms etc . Perspectives for collaboration within projects, publications and visits are discussed. It is agreed to highlight the main interest in the field of AI techniques and application in each member's domain.

#### - RWG2:

The scientific research work has been planned, in the realm of the research subject. The group decided to identify common research interests, considering interdisciplinary research domains. Furthermore it was agreed that each member should propose two research ideas, which should generate, first, a scientific survey paper, then a contribution paper.

#### - RWG3:

Members had first introductory meetings planned by each leader separately within TU/e and UT Cluj members. Discussions have shown that finding common interest on only electrical machines and drives is challenging considering the diversity of research directions of the involved researchers. One of the changes from the original project plan has been in the Research Subject of RWG3. Within the RWG3, which focuses on AI-based electrical machines and drives, the research topic has been expanded towards energy storage and batteries due to the shifting research focus of the research work group leaders. TU/e brought an external specialist with industrial connections in this topic to the exploratory meetings.

- **RWG4:**

In the first meetings, a roadmap is discussed on how to proceed in the most effective way. Each involved group member made presentation about the main research lines and interest and possibilities on how/where to cooperate.

### Research workgroups working meetings:

Research work group working meetings will be reported in the second year of the project, based on Gantt Chart.

### Short term visits:

Related short term visits are reported below under specific RWG. Please see the specific activity report for the details in the Annex.

- **RWG1:**

Participated online meeting organised by TU Cluj with presentation entitled “RS1: Flexible and adaptable AI & digital solutions for renewable-based electrical energy sources, storage, and smart household and building equipment and devices integration in smart building, houses and nanogrids” by Miareza Shafiekhah presented it on behalf of Xiaoshu Lü.

- **RWG1 & RWG3:**

Representative of Typhoon HIL (Sergio Costa) visited the laboratory facilities of TU/e in Eindhoven in the Netherlands in September 2023

### Exchange forums

Consortium members jointly attended the International Conference on Future Energy Solutions (FES 2023) 12-14 June 2023 in Vaasa, Finland. This international conference <https://sites.uwasa.fi/fes2023/> was organised by the University of Vaasa. A dedicated Exchange forum was held for Ditartis on 13<sup>th</sup> June in the form of a Panel Session. The members introduced themselves, their activities and work focus of Ditartis to project members and to the external researchers outside of the project.

### Conferences and events outside consortium attendance

Conferences and events outside of consortium attendance are reported below under specific RWG. Please see the specific activity report for the details in the Annex.

- **RWG1:**

The group members participated in total of 38 hours of coaching lectures.

One member (Ioana Cornelia Gros) attended SDEMPED 2023 (4th Edition of the IEEE International Symposium on Diagnostics for Electric Machines, Power Electronics and Drives, 28-31 August 2023, Greece) and presented the paper:

:

Ioana-Cornelia Gros, Xiaoshu Lü, Claudiu Oprea, Tao Lu, Lucian Pintilie, Artificial intelligence (AI)-based optimization of power electronic converters for improved power system stability and performance.

- **RWG3:**
- Several members attended INTERMAG (International Conference on Magnetism) conference which took place in Sendai, Japan May 15-19 2023, please find below the list of these publications:
- Inductance Map Regression of Doubly Excited Electrical Machines Considering Cross-Saturation. G. Bayazit, E. Ilhan Caarls and E. Lomonova
- Comparison of the Finite Element Method and High Order Isogeometric Analysis for Modeling Magnetic Vector Hysteresis. B. Daniels, M. Curti, T. Overboom and E. Lomonova
- Development and Experimental Verification of Magnetic Loss Models for High-Speed Electric Drives. R. Zeinali, D. Krop and E. Lomonova
- Stator Optimization for a Novel Magnetic Levitation Actuator. G. Zuidema, D. Krop and E. Lomonova
- Semi-analytical modeling for linear motors with conductive media in high-dynamic applications. A. Desikan, D. Krop, B. De Bruyn and E. Lomonova
- Investigation of Electromagnetic Formulations for Efficient Analysis of MFTs. S. Pourkeivannour, M. Curti and E. Lomonova
- Modeling and Experimental Validation of Voltage Distribution in MFTs with Foil Windings. K. Iwai, S. Pourkeivannour, M. Curti and E. Lomonova

#### 4. DEVIATIONS FROM THE WORKPLAN

No deviations are reported from the workplan.

#### 5. ANNEX (ACTIVITY REPORTS)

##### Research workgroup RS1 (RWG1):

**Flexible and adaptable AI & digital solutions for renewable-based electrical energy sources, storage, and smart household and building equipment and devices integration in smart building, houses and nanogrids**

**Research workgroup leaders:** Ioana Cornelia Gros

**Reporting period:** March 2023-May 2023

##### Meetings:

Type of the meeting: online

Date of the meeting: 28.02. 2023; 01.03.2023

Participants: RS1 members

Short minute of the meeting:

##### Discussions:

1. Short presentation on attendances' fields of interest  
Caio Osorio from Typhoon presented an overview of their equipment and technical solutions for testing control strategies, AI algorithms etc
2. Perspectives for collaboration within projects and articles, possible visits.
3. Action list
  - To highlight the main interest in the field of AI techniques and application in our domain.
  - To meet the research group members
  - To discuss RS1 related topics

##### Results:

- Scientific papers

Artificial intelligence (AI)-based optimization of power electronic converters for improved power system stability and performance by Ioana Cornelia Gros, Xiaoshu Lü, Claudiu Oprea, Tao Lu, etc, submitted to an international conference

- Identification of interesting calls

HORIZON-CL5-2023-D4-01 - Interoperable solutions for positive energy districts (PEDs), including a better integration of local renewables and local excess heat sources

- New proposals

Flexible hybrid solutions for interoperable energy systems in Positive Energy Districts,  
Acronym: FlexPED

- Short visits

Participated online meeting organised by [Technical University of Cluj](#) with presentation entitled “RS1: Flexible and adaptable AI & digital solutions for renewable-based electrical energy sources, storage, and smart household and building equipment and devices integration in smart building, houses and nanogrids” (Miareza Shafiekhah presented it on behalf of Xiaoshu Lü)

- Expert visits
- Participated 6X6+2=38 hours of coaching lectures.

Future work:

1. Jointly attend an international conference organised by the University of Vaasa in June 2023.
2. Produce more scientific papers.
3. Jointly apply more EU projects.
4. Mentor young researchers.

## Research workgroup RS2 (RWG2):

### AI-based demand side management architecture

**Research workgroup leaders:** Miadreza Shafiekhah, Adrian Augustin Pop

#### Members:

Razvan Bocu (SISW)

Mahoor Ebrahimi (UV)

Sahar Seyedbarhagh (UV)

Ahm Shamsuzzoha (UV)

**Reporting period: March 2023-May 2023**

#### Meetings:

1. Type of the meeting: online (Teams)

Date of the meeting: 09.05.2023

Participants: **Adrian Augustin Pop; Razvan Bocu; Anca Constantinescu**

Short minute of the meeting: The scientific research work has been planned, in the realm of RS2. It was decided that we should identify common research interests, considering our interdisciplinary research domains. Furthermore, each of us should propose two research ideas, which should generate, first, a scientific survey paper, then a contribution paper.

2. Type of the meeting: online (Teams)

Date of the meeting: 30.05.2023

Participants: **Adrian Augustin Pop; Razvan Bocu**

Short minute of the meeting: Razvan Bocu proposed the two research ideas, as agreed. We are waiting for the other team members from RS2 to do the same, in order to be able to move forward with our activity.

**Research workgroup RS3 (RWG3):****AI-based electrical machines and drives (design, analysis, control, testing)****Research workgroup leaders: Mircea Ruba (UTC), Esin Ilhan Caarls (TU/e)****Reporting period: March 2023-May 2023****Meetings:**

Type of the meeting: online

Date of the meeting: 17.02.2023,

Participants: RS3 Members

- Short minute of the meeting: Extend the focus of the RWG3 to batteries, ie. *AI-usage in electrical machines, drives and batteries (design, analysis, control, testing, life time estimation...)*
- It is difficult to have efficient meetings with a large work group. Work group leaders will arrange separate meetings with the members on their side to explain what DITARTIS is about and what the individual expectations are.
- Action: Mircea will arrange Romania side (UTC & Siemens), March
- Action: Esin will arrange NL side (TUE & etc.), March  
Online gathering of RGW3 beginning April with all work group members,

Type of the meeting: online

Date of the meeting: 10.05.2023,

Participants: RS3 Members (on Romanian side and on Nederland side)

- Short minute of the meeting: Finding common interest of work between partners
- Deciding on battery focus regarding future research topics
- Seeking for future project proposal topics in common approach

**Results:**

- Scientific papers  
In development: using prerecorded data for battery behavioral descriptions
- Identification of interesting calls  
In searching progress
- New proposals  
Implementing AI into battery identification process together with machine learning
- Short visits  
Participation at the onsite *First training event 23-24 April 2023* organized at TUCN

**Future work:**

1. Start implementing of AI methods for different battery systems development
2. Prepare the future publications
3. Seek/find/apply for funding at EU projects

**Reporting period: June 2023-September 2023****Meetings:**

Type of the meeting: online

Date of the meeting: 30.06.2023,

Participants: RS3 Members (on Romanian side and on Dutch side)

Topics addressed:

- Finding common interest on only electrical machines and drives is challenging considering the diversity of research directions
- UTC has ambition to move more in direction of batteries. Combining batteries and e-drives for mobility applications is a common ground.
- TUE will bring a battery specialist for the next meeting with industrial connections to the talks.

Type of the meeting: online

Date of the meeting: 21.07.2023,

Participants: RS3 Members (on Romanian side and on Dutch side), & battery specialist Steven Wilkins

Topics addressed:

- TUE brought a battery specialist with industrial connections to the meeting, dr. Steven Wilkins, who has both connections in academic and industrial setting.
- The aim of this meeting was to support UTC to extent network and approach for the battery research questions and set a clear direction. UTC has not much experienced researchers available in this direction.
- Battery specialist have an introduction to the topics relevant and up-to-date regarding battery research in industry both in mobility applications and energy storage. Digital Twin and AI methodologies are discussed.

- There was a Q&A session on the specific bottlenecks experienced from UTC side on the battery research.
- Different networking websites and platforms are introduced to UTC on this research.
- We will have regular meetings on a monthly basis and collaborate on a general paper for Digital Twin technologies on vehicle powertrain.
- Next meeting is planned after summer holiday, end September/begin October.

## **Research workgroup RS4 (RWG4):**

**Data driven condition monitoring and predictive maintenance in EMS**

### **Research workgroup leaders:**

Jose A. Antonino-Daviu

Jose E. Ruiz-Sarrio

Sorin Cosman

Mazaher Karimi

### **Reporting period: March 2023-May 2023**

#### **Meetings: RWG4 leader meeting**

Type of the meeting: online

Date of the meeting: February 27<sup>th</sup>

Participants: Sorin Cosman, Jose A. Antonino-Daviu, Jose E. Ruiz-Sarrio, Mazaher Karimi

Short minute of the meeting: Decisions about first exploratory meeting and short introduction of the research groups

#### **Meetings: EM1**

Type of the meeting: online

Date of the meeting: March 28<sup>th</sup>

Participants: Sorin Cosman, Jose A. Antonino-Daviu, Jose E. Ruiz-Sarrio, Mazaher Karimi, Sorin Cosman, Daniela Sasu, Razvan Bocu, Alexandra Baicoianu, Meysam Pashaei

Short minute of the meeting: Exploratory Meeting 1, presentation about the main research lines and interest of the different involved research groups.

#### **Results:**

No quantitative results have been produced up to the date due to the early stage of the project.

#### **Future work:**

The second exploratory meeting is scheduled for the second week of June, where direct links between the groups for potential collaboration will be identified.