DRIVEMODE

Integrated Modular Distributed Drivetrain for Electric & Hybrid Vehicles

Document title: D1.5 Project Status Report 1

D1.5: Project Status Report 1
WP 1, T 1.1

Authors: Alexander Smirnov (VTT)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°769989

DRIVEMODE

Technical references

Project Acronym	DRIVEMODE
Project Title	Integrated Modular Distributed Drivetrain for Electric & Hybrid Vehicles
Project Coordinator	Mikko Pihlatie VTT Technical Research Centre of Finland mikko.pihlatie@vtt.fi
Project Duration	November 2017 – October 2020 (36 months)

Deliverable No.	D1.5
Dissemination level*	PU
Work Package	WP 1 - Coordination
Task	T1.1 - Administrative and financial management
Lead beneficiary	VTT
Contributing beneficiary/ies	All
Due date of deliverable	31 November 2018
Actual submission date	20 December 2018

* PU = Public

PP = Restricted to other programme participants (including the Commission Services)

RE = Restricted to a group specified by the consortium (including the Commission Services)

CO = Confidential, only for members of the consortium (including the Commission Services)

v	Date	Comment	Author	Beneficiary
0.1	5/11/2018	Initial draft	Alexander Smirnov	VTT
0.2	10/12/2018	Second draft	Alexander Smirnov	VTT
0.3	11/12/2018	TMT review	Laura Tribioli	SCIRE
0.4	12/12/2018	Corrections are made	Alexander Smirnov	VTT
0.5	12/12/2018	TMT approval	Laura Tribioli	SCIRE
1.0	20/12/2018	Final check and submission	Mikko Pihlatie	VTT

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Executive Summary

The purpose of the deliverable is to provide concise evaluation of the project and state the current achievements. It contributes to Task 1.1 Administrative and financial management and objective of financial contribution management and its distribution to consortium.

The status of the project is healthy, all tasks are executed according to the grant agreement (GA). Deep cooperation through various communication channels have been established between partners providing fruitful and flexible working environment. The project has gone through initial requirement specification, iterative concept design and selection phases, now detailed design of components and manufacturing processes are ongoing. In parallel, tasks related to testing specification and integration to the demonstrator vehicle are ongoing.

The project has communicated its results mainly through the website and LinkedIn group. In addition, partners have presented advancements on several conferences.

The usage of financial resources and working hours is reasonable and corresponds to the current state of the project. Slight deviation in timely submission of deliverables (on average 20 days) did not provide the impact on the project and proactive measures have been taken to eliminate this lag.

Attainment of the objectives and if applicable, explanation of deviations

The deliverable outlines the overall progress of the DRIVEMODE project including the progress of each work package for the first 12 months. It contains the relevant information on the completed tasks, financial spending and usage of the resources. Achievements of each work package are listed and possible concerns are evaluated. The document is also complemented with the list of publications that has been presented and that are planned for the future. Thus, it can be stated that all relevant objectives for this deliverable were achieved.

The delivery is slightly delayed to collect the latest results from partners and discuss them on the general assembly meeting.

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Abstract

The project status report outlines the overall progress of the DRIVEMODE project including the progress of each work package for the first 12 months. It contains the relevant information on the completed tasks, financial spending and usage of the resources. Achievements of each work package are listed and possible concerns are evaluated. The document is also complemented with the list of publications that has been presented and that are planned for the future.

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Project Overview

Progress of Tasks

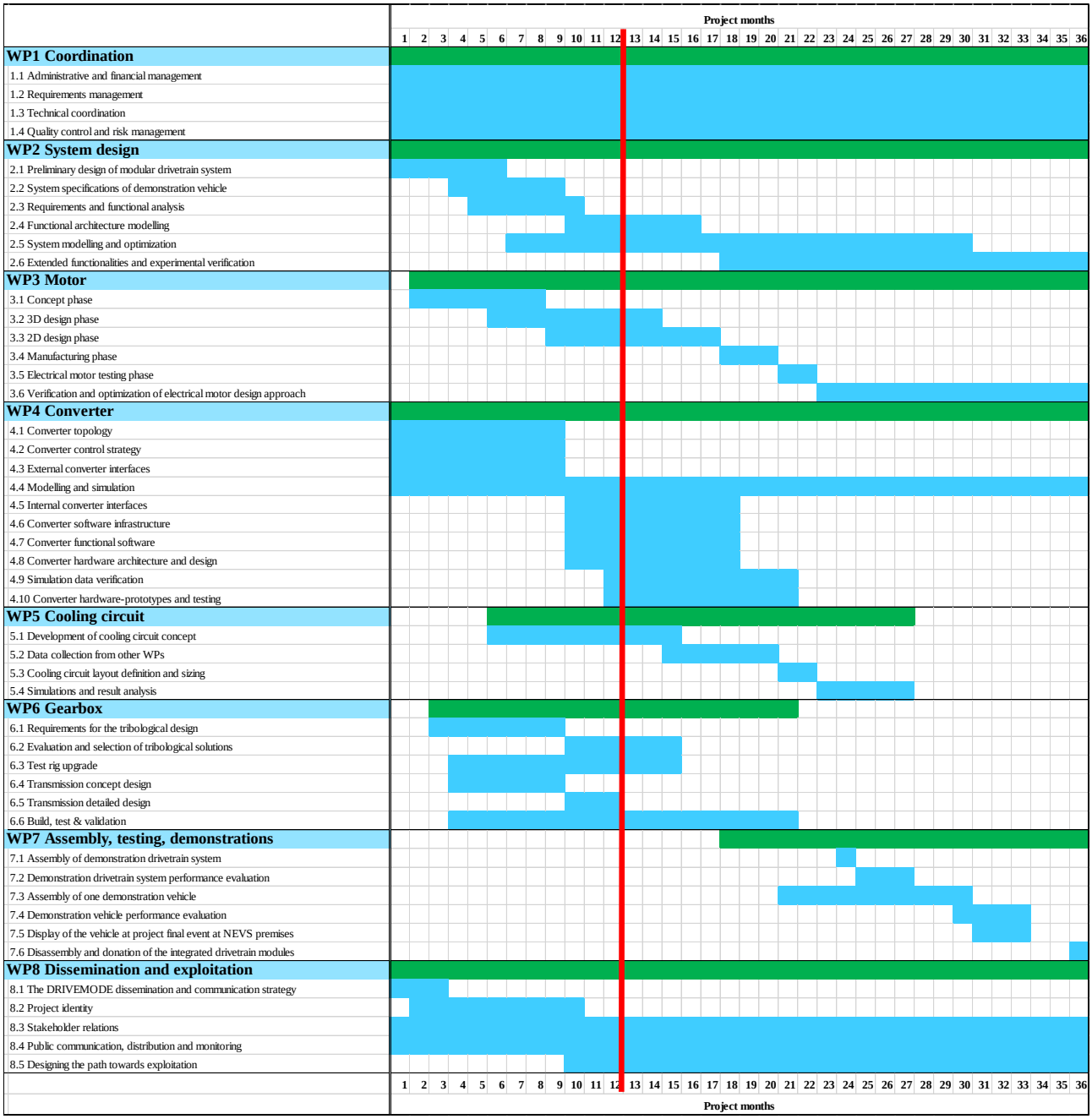

Figure 1 Gant chart of DRIVEMODE project

The project has reached its second milestone on 15th of November with the submission of D2.2 System specifications of prototype. The milestone has been delayed because of the deliverable review process to insure the agreement between all partners. This did not have any impact on the project as the information has been communicated earlier. By reaching the second milestone

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the project has shifted from the concept phase of design and evaluation of architectures to the detailed design of components and manufacturing. Thus, the most suitable concept according to the project goals has been selected and its components are further developed. This is demonstrated on the overall Gant chart in Figure 1 by finalizing tasks T2.1, T2.2, T2.3, T3.1, T4.1, T4.2, T4.3, T6.1, T6.4, and T6.5.

Gearbox design (work package 6 (WP6)) is already frozen and proceeded to manufacturing, while inverter (WP4) and electrical motor (WP3) are finalizing detailed design. The other WPs are also proceeding according to the grant agreement (GA).

Finances and usage of resources

The information on the resources usage is collected from the partners every 6 months to have continuous feedback on the financial status. In Figure 2 the budget spending estimated on the task duration and allocated resources is presented, along with the actual values. It can be noted that there is underuse of resources, the details are presented in Figure 3. This is explained by the inaccuracy of the estimates, where the procurement of components cannot be accurately included. The overall trend to decrease the underuse as shown in Figure 3 demonstrates that situation is healthy and will be improved as the procurement processes are finalized. This is also supported by the plot of working time usage in

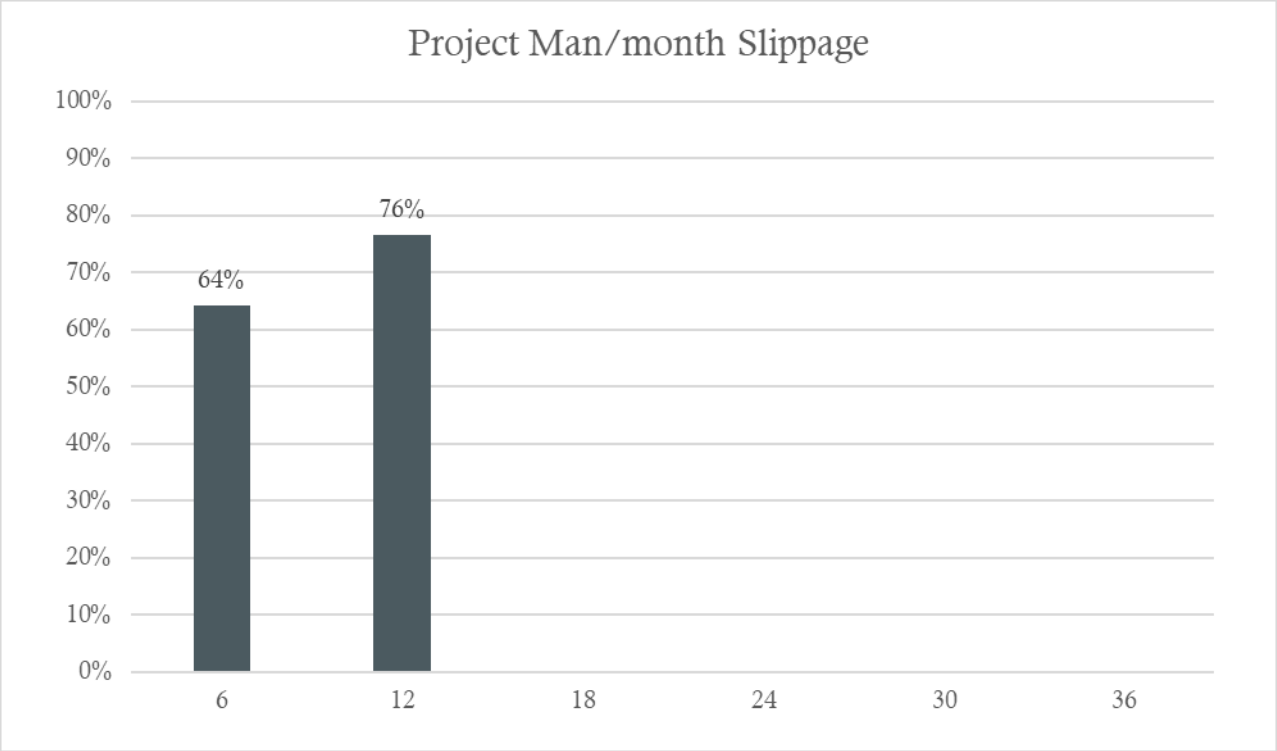

Figure 4, which demonstrates how much working time has been used compared to the expected time. The numbers are slightly bigger than the ones corresponding to the financial budget as in the initial phase human resources are more intensively used for the design process.

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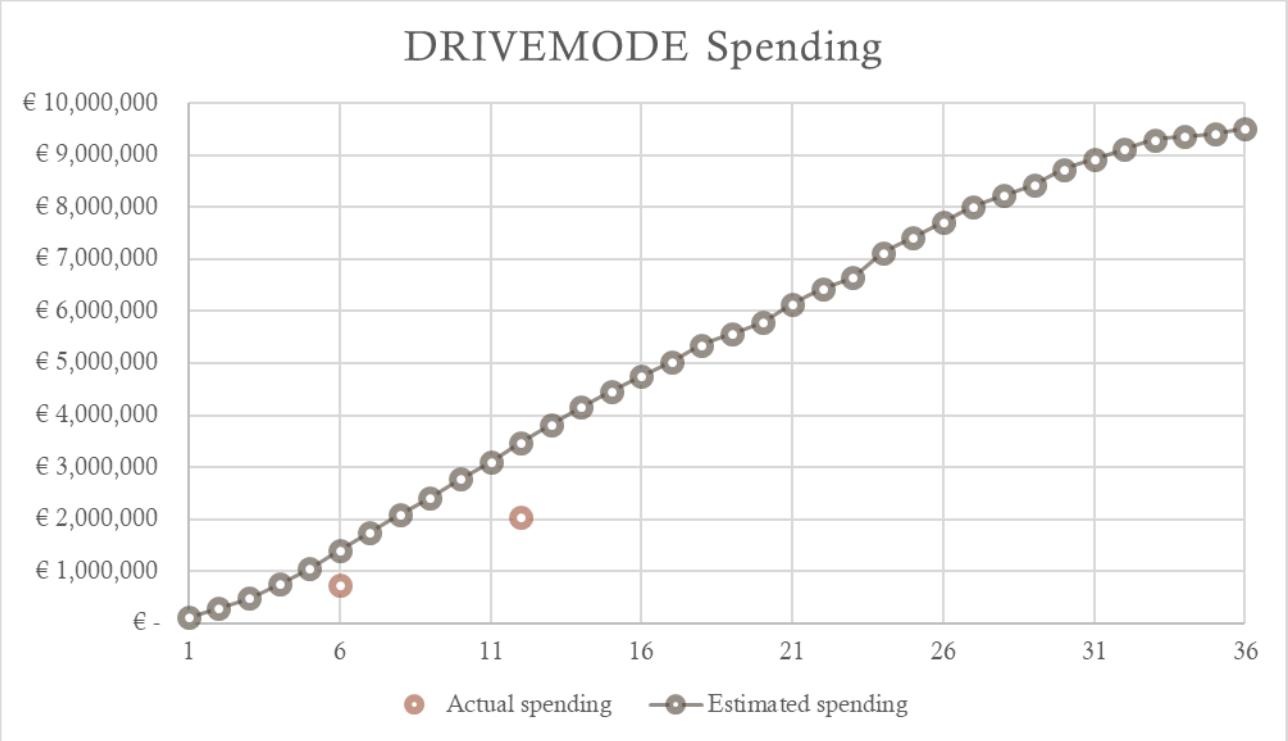

Figure 2 DRIVEMODE project overall budget usage

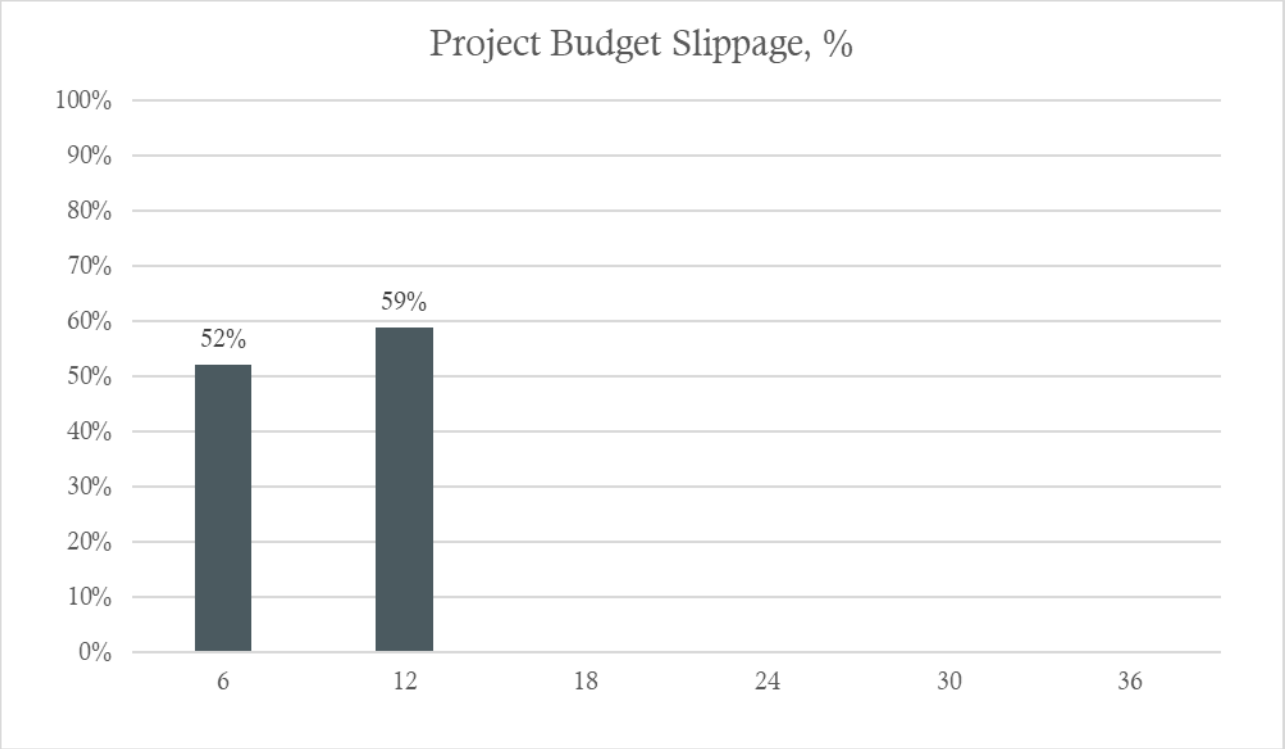

Figure 3 DRIVEMODE budget slippage

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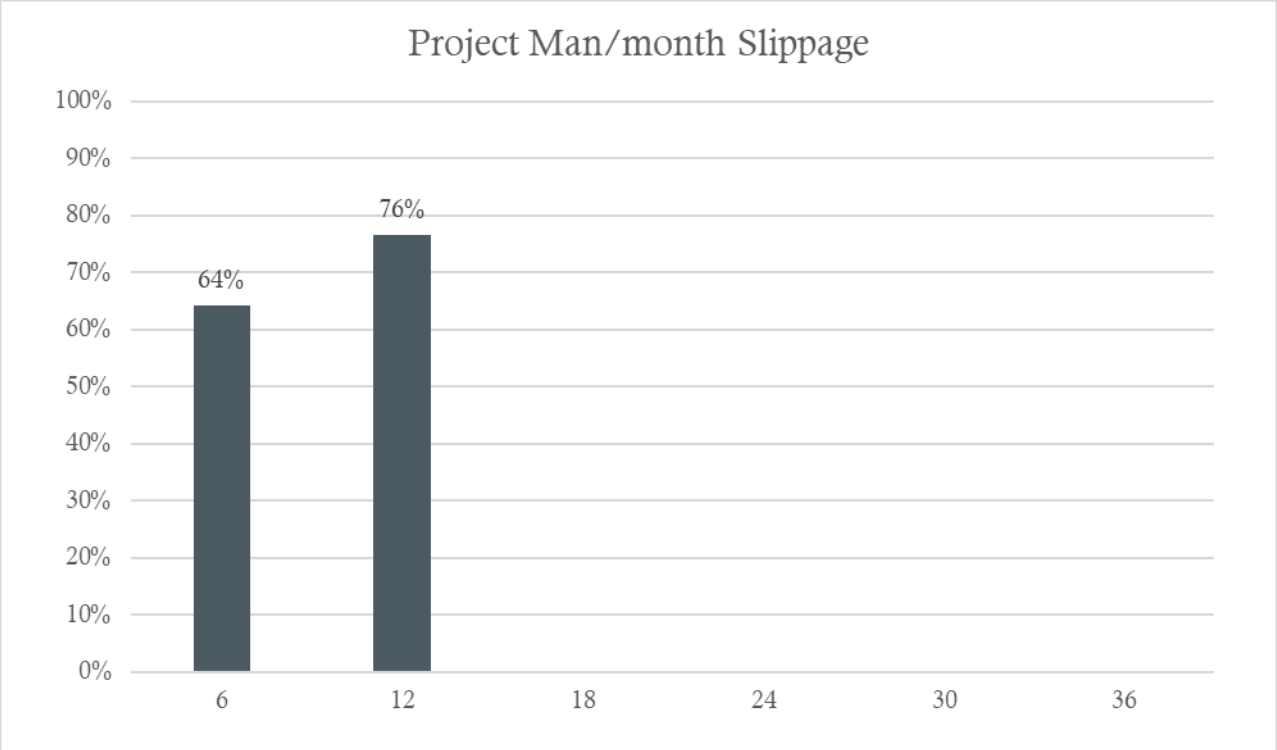

Figure 4 DRIVEMODE usage of man/months slippage

It can be concluded that the financial state of the project is healthy and differences are mostly related to the limitations of the method used for the estimations.

Deliverables

Deliverable review process is a part of T1.4 Quality and risk management, which insures the agreement between consortium partners and high quality of submitted deliverables. The information on the status of deliverables is continuously collected and evaluated. The deliverable slippage with respect to GA is presented in Figure 5. The overall conclusion is that most of the deliverables are delayed for the average of 20 days. The main reason is negotiation between partners to reach the common agreement. The situation is under close supervision and several proactive steps have been adopted to avoid the delays in the future. It can be also noted that so far delays for the deliverables did not have impact on progress of tasks as it was demonstrated in section .

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Figure 5 Deliverable slippage with respect to the grant agreement

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WP1 - Coordination

Work Carried Out

Task 1.1 Administrative and financial management (M36, in progress)

- Partners are provided with the common workspace for the information exchange
- The guidelines for the data storage, communication and information exchange are presented
- To keep awareness and motivation between partners the following is adopted
  - Monthly internal newsletter shared for all persons
  - Internal bi-monthly status report presentation of work packages
  - Bi-monthly survey for project participants to provide their feedback anonymously on the project development

Task 1.2 Requirement management (M36, in progress)

- The requirement management system is introduced and launched for the common use
- A dedicated person is working on the requirement collection and evaluation with the help of partners
- The requirement system works as a foundation for the functional analysis in WP2

Task 1.3 Technical coordination (M36, in progress)

- To proceed with initial multidisciplinary and multiobjective design procedure the Design Group has been established
- Meetings were carried on weekly basis with the aim to steer the development according to the project aims
- A number of workshops on finding common grounds and tailoring the technical solution have been conducted during face to face project meetings
- To apply iterative and adaptive design procedure the process based on visual management has been adopted
- A number of integration groups between work packages are established for certain areas
  - Software integration
  - Data acquisition and instrumentation
  - Drivetrain integration
  - Computer aided design (CAD) models maintenance and integration

Task 1.4 Quality and risk management (M36, in progress)

- The procedure for the internal review of deliverables is established
- Review and clarification of the overall schedule has been completed
- Testing plan has been prepared and evaluated
- Risk assessment is repeatedly conducted and risk mitigation strategies are prepared

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Achievements and possible areas of concern

Achievements

- D1.1 Project handbook is prepared
- D1.2 Collaboration workspace is launched and under extensive use
- Requirement management system is launched and under use
- D1.3 Data management plan is prepared and shared for partners
- Integration teams are established for actions that require cooperation between work packages
- The iterative design of the drivetrain and selection of concepts has been competed
- Periodic communication channels are established

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WP2 – System Design

Work Carried Out

Task 2.1: Preliminary design of modular drivetrain system (M6, completed)

- Preliminary design of modular drive system is completed and a report is submitted to EU.
- A peer reviewed conference paper titled "Multiple electrical machines applied for high drive train efficiency" based on the pre-study conducted for the project was presented at International Conference on Electrical Systems for Aircraft, Railway, Ship Propulsion and Road Vehicles (ESARS) and International Transportation Electrification Conference (ITEC), Nov 2018.
- Currently, the academic value of D2.1 is evaluated to convert it into a publication.

Task 2.2: System specifications of demonstration vehicle (M9, completed)

- The documentation of this task presents the specification of the demonstration vehicle. The specifications outlined here are at System Level (i.e. at Vehicle Level) and at Subsystem Level (i.e. Battery, Electrical machine, Cooling system and Gearbox).
- The subsystems performance specifications and specifications on interfaces between them are largely based on the existing demonstration vehicle, i.e. NEVS 9-3 EV.
- In the end of the document, the last two sections present the Packaging Models shared amongst the consortium members and the driveline layout for the prototype vehicle respectively.
- D2.2: The deliverable is delayed by 3 months to ensure agreement within WPs on the specifications and the subsystem level requirements. This delay affects neither the project schedule nor the project outcomes.

Task 2.3: Requirements and functional analysis (M11, completed)

- The task was dedicated to analyzing the system specifications, function requirements, and the project goal statement, to identify set of design criteria crucial for screening and selection of the various concept selection, therefore, making comprehensive decision in the design project.
- A report has been delivered, summarizing the research to identify functional and performance criteria to provide guidance in decision-making and for evaluation and selection of the best concept. There are two reports, one summarizes the methodology used and an application example, and the other comprises the matrix table of the methodology for evaluating the concepts.
- The deliverable introduces the instrumentation to evaluate different concepts, defines criteria and provides their comprehensive analysis. Thus, it can be stated that all relevant objectives for the deliverable were achieved. In addition, the deliverable presents a set of tools for task 1.3 Technical coordination.

Task 2.4: Functional architecture modelling (M16, in progress)

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- The work done in task 2.3 Requirements and functional analysis provides basis for this task 2.4 Functional architecture modelling. The report provides the tools and basement for the task.
- The task comprises several steps and the work done so far consists of:
  - Collecting design data and researching documents from the various relevant WPs.
  - Defining the system architecture based on prototype concept for the clear definition of the interfaces in the overall system (including other subsystems, e.g. Battery, control) by expanding system boundaries.
  - The next step is analyzing the system architecture considering modularity, integration, scalability, distribution, and cost effectiveness of the design.
  - The final report will be delivered in the early months of 2019.

Task 2.5: System modelling and optimization (M30, in progress)

- Literature review on modeling powertrain components such as electric machine and inverter for system level simulation is carried out.
- The tool for modelling is finalized. MATLAB script will be used for modelling the various components which will include electric machine, power electronics, gear box and battery. The modelling in the beginning will be done to evaluate steady state performance which will later be updated to include dynamic performance in the presence of control loops.
- A preliminary model of electric machine using flux linkage maps is developed for system simulation which can be used to estimate electric machine phase current, voltages, power factor etc. in steady state with reference torque and speed generated from a standard drive cycle.

Task 2.6: Extended functionalities and experimental verification (M36, not started)

- Not yet started.

Achievements and possible areas of concern

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WP3 - Motor

Work Carried Out

Task 3.1: Concept phase (M8, completed)

- Literature survey and evaluation of possible solutions
- Two concepts of electrical machines according to specifications from WP2
  - Induction machine
  - Permanent magnet machine
- FEM modelling of both machines
- Evaluation and comparison of the concepts

Task 3.2: 3D design phase (M14, in progress)

- Detailed definition of interfaces to Inverter, Transmission and Vehicle cooling circuit
- Optimizing the permanent magnet synchronous machine (PMSM) electromagnetic and mechanical design
- Detailed definition of lamination design and airgap dimension
- Detailed design of E-Motor 3D CAD housing and shafts

Task 3.3 2D design phase (M17, in progress)

- 3D CAD modelling and preparation of drawings
- Prototype of round wire winding has been done
- 3D FEM simulations for thermal behavior using computational fluid dynamics
- Cooling optimization
- 3D calculations of optimal skewing to reduce the cogging torque
- Modal analysis and evaluations of resonant frequencies
- Bearing currents estimation and design of mitigation measures

Task 3.4 Manufacturing phase (M20, not started)

- Not yet started.

Task 3.5 Electrical motor testing phase (M22, not started)

- Not yet started.

Task 3.6 Verification and optimization of electrical motor design approach (M36, not started)

- Not yet started.

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Achievements and possible areas of concern

Achievements

- D3.1 Report on electrical motor requirements is prepared
- D3.2 Report and/or scientific publication on considered electrical motor technologies, evaluation matrix, concept decision is completed

Possible Areas of Concern

- Timely final design of the water jacket → due December 2019
- Timely final winding design → due December 2019
- Skewing definition in time → due December 2019
- Complete simulation set-up according to the requirements in time → due February 2019
  - Electromagnetic,
  - thermal

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WP4 - Converter

Work Carried Out

Concept (T4.1, T4.6)

- A technical concept study of an ISO26262 compliant inverter completed in 8/2018. Artefact produced at this stage was a document, "TECHNICAL CONCEPT: Visedo ISO26262 compliant inverter", presenting the technical safety concept of an ISO26262 compliant inverter for automotive domain. The document covers aspects such as:
  - non-functional requirements,
  - safety goals,
  - safety requirements,
  - technical safety concept,
  - software and hardware architecture options,
  - hazard analysis and risk management.
- Selection of power electronic concept with the aspects as:
  - topology,
  - paralleling of SIC-MOSFETs,
  - substrate,
  - die mounting technology,
  - design of high current path regarding inductance and current capability.

Hardware (WP4/T4.1, T4.3, T4.8, T4.10)

- Selection of control board CPU with option for fulfilling ISO26262 compliancy requirements of the automotive industry.
- Initial revision of the control board hardware design to be based on the Aurix TriCore CPU architecture.
- First control board revision PCB's are expected to come out of manufacturing by the end of 12/2018.
- First revision of the driver board hardware design based on Semikron ASIC architecture. Concept approval driver board revision available.
- Selection of other key components influencing size, cost or manufacturability of the converter such as:
  - MOSFET
  - connectors,
  - current sensors,
  - passive discharge,
  - voltage sensor.
- Initial revision of mechanical construction

Software (WP4/T4.2, T4.4, T4.6)

- Porting of existing Texas Instruments (TI) codebase to Aurix TriCore started and ongoing:
  - low level drivers,

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- OS integration,
- control loop algorithms,
- parameter system,
- fieldbus communication (CAN),
- support functions.

Systems (WP4/T4.3, WP2/T2.2)

- Review of systems specifications of the demonstration vehicle, to be built by NEVS, with Danfoss, NEVS and Semikron.

Modelling and Simulation (WP4/T4.4)

- Thermal modelling of
  - MOSFETs
  - Substrate
  - Cooling structure
- FEM simulations including optimizations in regard of thermal performance and fluidic flow for the converter with aspects as
  - materials of thermal path from die to coolant
  - pressure drop of cooler
  - different fin geometries in the heat sink
  - influence of die positions to the heat spreading
- Deliverable D4.2: Thermal simulation report of the converter
- Modelling of MOSFET losses
- Performance simulation of MOSFETs

Testing (WP4/T4.9, T4.10, WP3/T3.5)

- Initial thermal measurements to verify thermal modelling
- Initial test plan for inverter testing at Semikron defined
- Initial test program for IDM testing at Danfoss defined, consisting of:
  - initial test plan,
  - initial instrumentation plan.

Achievements and possible areas of concern

Achievements

- Technical concept study of an ISO26262 compliant inverter completed.
- First hardware design revision of the inverter's control board competed.
- Initial demonstrations vehicle systems specifications reviewed.
- Porting of existing inverter codebase to Aurix TriCore CPU architecture started by utilization of Aurix TriCore evaluation boards.
- Power electronics concept fixed.
- High SIC utilization due to simulation results.
- Main components selected.
- Concept approval board of the inverter's driver board available.

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Possible Areas of Concern

- (TECHNICAL) High rotational speed of the motor (>20 000RPMs) requires high switching frequency and fast control loop. With the pre-existing control implementation, the fastest control loop time level runs at 62,5 µs cycle period, requirements for decreasing the fastest control loop cycle period may arise.
- (TECHNICAL) Also related to the high rotational speed. May impose higher performance requirements to the actual output frequency of the inverter. If this realizes the DSP modulator implementation may have to be moved to the FPGA or equivalent technical solution.
- (RESOURCING) Increase of personnel and hours put in are expected to be increasing as the project timeline is shifting from design phase to implementation phase. Possibilities of increasing resourcing is being evaluated.

Deviations from GA

Objectives

- ISO26262 certified/compliant control software implementation with high ASIL level (e.g. ASIL C), would require a dedicated certification project, especially for an existing codebase, would be a rather large endeavor and thus would most likely not be feasible in DRIVEMODE timeframe. This objective is to be re-evaluated over time, but currently not viewed as a critical objective, in terms of functional inverter unit.
- Final details of mechanical interface between motor and inverter (T4.3) delayed due to unplanned dependencies on other construction details planned in T4.8.
- Actions of T4.8 and T4.10 started earlier than originally planned.

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WP5 – Cooling Circuit

Work Carried Out

Task 5.1: Development of cooling circuit concept (M15, in progress)

The work carried out during this period dealt with a preliminary analysis of the cooling system, aimed at the sizing of the coolant pump. The work has been divided into four main steps:

1. Data gathering from NEVS on the existing cooling circuit from the baseline vehicle; understanding of constraints;
2. Evaluation of need/possibility of improvements and modifications for the cooling circuit of the demo vehicle;
3. Data gathering from SEMIKRON and AVL for a rough estimation of the pressure drops and thermal loads of the components of the IDM;
4. Proposal of different solutions for the cooling circuit.

The preliminary analysis has highlighted that the pump, currently used in the baseline vehicle, might be undersized for the module under development. Regarding the radiator, it seems to be oversized, since the basic design is equal to the one of conventional petrol engines. This implies that there should not be any issue if the volumetric flow rate through the radiator increases with respect to its current operation, as expected for the F2 configuration.
The final output of this analysis was obviously affected by the main targets of the project, such as modularity, economic feasibility, reliability.
For sake of modularity, the layout with one pump for each module has been selected. Nonetheless, for sake of reliability, considering that the current pump has been tested and its effectiveness proved, the final choice for the coolant pump has been postponed until detailed data from the IDM components - on thermal loads and pressure drops - will be available. Finally, with respect to the economic feasibility, for the other components (i.e. radiator, fan) the devices currently used in the baseline vehicle will be employed in order to avoid time and resources-related expenses.
This part of the work was carried out by SCIRE, while NEVS participation was mostly in providing information about the existing components and system.

Task 5.2: Data collection from other WPs (M20, not started)

- Not yet started.

Task 5.3: Cooling circuit layout definition and sizing (M22, not started)

- Not yet started.

Task 5.4: Simulations and result analysis (M27, not started)

- Not yet started.

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Achievements and possible areas of concern

- The aim of WP5 is to design and evaluate the cooling circuit performance of the integrated vehicle system and one of the goals is to use the minimum number of cooling elements, in order to design a single cooling circuit for all devices. To respond to the need of modularity, one pump for each module must be used, even if this seems to clash with one of the WP goals. With respect to the need of splitting the circuit among the IDM's components, from a preliminary analysis of the thermal loads, it seems that this can be avoided and one single cooling circuit for all the devices can be used. At this moment the only concerns are about the time required to acquire a new pump, if needed, and the issue related to the coolant inlet temperature which has been set equal for the two components of the IDM.

Deviations from GA (if applicable)

- There has been a deviation in the use of resources between actual and planned use of resources in Annex 1, especially related to person-months per work package, owe to the activities carried out in the first year of the project, which have required a higher effort than the estimated. In particular, another person has been added to the WP with an increase of the actual use of resources to 5.4 P/M instead of 2 P/M.

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WP 6 – Gearbox

Work Carried Out

Task 6.1: Requirements for the tribological design (M9, completed)

- Translation of requirements from vehicle level to gearbox system
- Evaluation and definition of limits and possible solutions from the gearbox point of view

Task 6.2: Evaluation and selection of tribological solutions (M15, in progress)

- Selection of gear coatings for evaluation through physical testing
- The tests with a twin-disc tribometer consisting of steel discs and the selected gear transmission oil, are carried out under experimental conditions that represent the lubrication and contact pressure conditions under average and extreme conditions in the prospective gear contacts.

Task 6.3: Test rig upgrade (M9, in progress)

- Preparations for tribological tests, with the aim of pre-evaluating surface roughness values and DLC-coatings for the transmission gearwheels
- Samples has been made from the chosen gear steel grade, and with representative hardening and surface finishing

Task 6.4: Transmission concept design (M15, completed)

- A concept selection phase has been carried out in the following steps:
    1. multiple concepts for the transmission were generated
    2. factors of selection identified
    3. factors assigned weights of importance
    4. concept given a ranking of the factor, resulting in a final selection of a transmission design to develop.

Task 6.5: Transmission detailed design (M12, completed)

- Concept design of the selected concept has been completed
    - Computer aided engineering to simulate and analyze the transmission design
    - Validation of a computer aided engineering tool to optimize and analyze the lubrication system
    - Analysis of concept housing model with computer aided engineering tool
    - CAD model of complete hardware within scope of supply of work package 6

Task 6.6: Build, test & validation (M21, in progress)

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- Support in integration activities of drive module in packaging space in demo vehicle
- Test plan for gearbox testing

Achievements and possible areas of concern

Achievements

- Concept design completed
- Test plan completed
- Highest effort as expected during concept phase and during this time BorgWarner bought contractor service. Overall budget on track.

Possible Areas of Concern

- No full NVH testing on system level

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WP7 - Assembly, testing, demonstrations

Work Carried Out

Task 7.1: Assembly of demonstration drivetrain system (M24, not started)

- Not yet started.

Task 7.2: Demonstration drivetrain system performance evaluation (M27, not started)

- Not yet started.

Task 7.3: Assembly of one demonstration vehicle (M30, in progress)

- 3D model of the front end of the prototype vehicle was provided to all the consortium members.
- Functional Safety discussion and evaluation according to ISO 26262, was done with project partners SEMIKRON and Danfoss.
- Provided specific information on mechanical interfaces (to other subsystems in the prototype vehicle) for IDM design, HV and LV electrical and IDM cooling.
- Organized the vehicle integration kick-off meeting at NEVS. Mock up model of the front end engine bay of the prototype vehicle was demonstrated to participants. Various issues regarding the mounting of IDMs were discussed in detail and a formal integration team was setup
- Participated in integration group skype meetings to evaluate and select concepts for IDM interface to the vehicle structure (sub-frame) and the wheels.
- Initiated communication and SW integration activities. Discussion is ongoing with regards to CAN and SW integration with Danfoss and SEMIKRON.
- 800V battery development is underway. A functional 800V test bed has been developed to test and verify the functionality and safety of the 800V system before packaging it to the vehicle.

Task 7.4: Demonstration vehicle performance evaluation (M33, not started)

- Not yet started.

Task 7.5: Display of the vehicle at project final event at NEVS premises (M33, not started)

- Not yet started.

Task 7.6: Disassembly and donation of the integrated drivetrain modules (M36, not started)

- Not yet started.

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Achievements and possible areas of concern Achievements

- Established communication and interaction with project partners, and formed two integration teams (Mechanical Integration team and SW integration team) at project level to facilitate the integration and assembly work for the demonstration vehicle.
- Three teams (NEVS internal squads) have been formed to work on DRIVEMODE deliverables. These three squads are coordinating internally and externally (with other DRIVEMODE partners) to successfully realize a functional demonstration vehicle. Following are the details of the working squads:
  - DRIVEMODE-REESS Squad: Team of 6 engineers tasked with design and development of the 800V battery system.
  - DRIVEMODE- Vehicle Squad: Team of 7 engineers tasked with interface design (both mechanical and electrical) of the IDM for a functional demonstration vehicle.
  - IVC- Core: Team of 6-7 SW engineers, part of their task is to ensure SW integration of the vehicle controller with DRIVEMODE IDMs (inverter), other HV/LV components and CAN signals.
- **Mechanical Integration**: Concept selection and preliminary design for IDMs mounting to the sub-frame and completed. Further evaluation for the dynamic loading and the mechanical interference of various components are ongoing.
- **800V Battery System**: BMS (Battery Management System) installed on 32/34 battery modules and BDU (Battery Disconnect Unit) tested for charging, loading, and overall safe operation at vehicle level. Preliminary packaging study done to design a battery box suitable for the demonstration vehicle.
- **SW Integration**: Establish communication with Danfoss and SEMIKRON. Shared information regarding SW architecture and CAN protocol.

Possible Areas of Concern

- **800V Charging Station:** Currently at NEVS, all the charging infrastructure is for 400V system. To test the charging functionality of 800V battery system, an 800V charging station is essential. This issue has been flagged and NEVS is looking into possible solutions.
- **HV Architecture:** Various components in the existing NEVS 9-3 EV operate at 400V (like DCDC 400-12V converter, On-board charger and AC compressor/heater). There are ongoing activities to find the possible solution for this issue. However, NEVS engineers view this as a concern mainly due to unavailability of off-the-shelf components rated at 800V. Furthermore, this issue will not affect the main objective of the demonstration vehicle but will only reduce the ride experience of the demonstration vehicle.
- **SW Integration:** Some incompatibility issues with CAN Protocol (especially Identifier bits), with the inverter-VCU SW interface. SW integration team is further evaluating the issue and looking for possible solution.

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WP8 - Dissemination and exploitation

Work Carried Out

During the first year of activity, the core dissemination and communication activities have been launched in view of building the DRIVEMODE identity (both visual and written) in a consistent and enduring manner throughout the whole project duration. The main goal of the first dissemination materials developed (including, project logo, word and power point templates, project website, project animation video and flyer) has been to raise awareness upon the innovative approach of DRIVEMODE, its expected impacts and core objectives.

Task 8.1: DRIVEMODE dissemination and communication strategy (M3, completed)

- DRIVEMODE D&C plan contains the main strategic and operative guidelines that shall govern the overall dissemination and communication strategy. Deliverable D8.1 has been submitted according to the DoA on M3: it constitutes the core document outlining the WP8 activities and develops a detailed and harmonized strategy including DRIVEMODE targets, key messages, visual identity, reporting templates, online and offline channels.

Task 8.2: Project identity (M10, completed)

- The **DRIVEMODE logo** has been developed by first identifying the DRIVEMODE's brand personality, which highlights the project's main features, characteristics and elements to be conveyed when communicating DRIVEMODE. Based on the outcome of this analysis, four visual proposals (logos) have been developed by ICONS and shared with the project coordinator, to jointly select the most representative one for the project. The official Brandbook has then been produced and shared among the partners, serving as official rulebook for everyone involved in the project, particularly when preparing communication and dissemination materials for specific events.
- Based on the visual identity and the key messages outlined in D8.1, the official project **flyer** has been produced and printed in 1500 copies, for project partners to use it as core dissemination materials while participating to fairs, conferences and events. To mark this achievement, D8.4 has been produced and submitted on M10.
- The DRIVEMODE **short animation video** has been delivered on M11 (as described in D8.3). The storyline of the video has been drafted according to the main target addressed, content, distribution channel and messages. The main objective is to raise awareness upon project objectives and to present the project in an easy-to-understand way through a web-video based on animations, simulations and info-graphics and addressing potential adopters at large.
- In strong synergy with WP1, the partners' **internal repository** has been developed for the consortium to exchange live documents and to act as a repository of institutional information and deliverables of the project. Each partner has been attributed with a username and password to log-in and a dedicated link to access the repository has been included in the footer of the homepage of the website.

Task 8.3: Stakeholder relations (M36, in progress)

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- **Dissemination Tools.** Within the period of analysis, one press release has been produced (in English) and distributed towards European and global information multipliers and online media i.e. AlphaGalileo, Cordis Wire, and other information platforms and thematic portals.
- **Networking, clustering and events.** DRIVEMODE partners will participate in various events such as conferences, fairs, workshops, roundtables and brokerage events to foster the project's visibility, expand the stakeholders' community and raise the awareness of the attendees regarding the DRIVEMODE project. As far as clustering activities are concerned, DRIVEMODE representatives from The University of Ljubljana made a presentation about the e-motor design in the framework of the World Magnetic Conference during Colitech 2018 (26-27 September 2018, Pordenone, Italy). This conference represented the first tangible joint dissemintation initiative carried out by GV-04 projects DRIVEMODE and ReFreeDrive.

Taks 8.4: Public communication, distribution and monitoring (M36, in progress)

- As far as **social media** is concerned, since the kick-off meeting the hashtag #DRIVEMODEH2020 has been launched to enable the monitoring of the conversation around the project on Twitter and collect impact data. In addition to Twitter and in coordination with the fellow GV-04 projects ModulED and ReFreeDrive, a common LinkedIn Corporate Page (called *Electric Drivetrain Innovation Cluster*) has been launched and it is jointly manned by the Dissemination leaders of the three projects.
- **Website and social media.** Before the release of the project website, ICONS developed a **landing page** (M2) to provide with an official presence of the project on the web since its beginning, contact details of the project coordinator and a call to action to follow the conversation happening on social media and tracked by the official hashtag #DRIVEMODEH2020. As outlined in D8.2, on M4 the landing page has been replaced with the official project website (http://drivemode-h2020.eu), which constitutes the main source of information regarding project activities and results and it will be regularly updated with project documents, news and events. A specific attention has been devoted to the DRIVEMODE homepage, which has been designed in view of creating an attractive narrative about the innovative aspects of the project, raising interest on the project through the adoption of a simple tone of voice and making use of visual elements and key messages. The website will be continuously updated as new contents associated to the project results development, editorial production progress, participation of partners' to events, clustering activities with fellow GV-04 projects.

Task 8.5: Designing the path towards exploitation (M36, in progress)

- Within the reference period of the current report, a draft structure of the **library of exploitable results** (namely, the Drivemode powertrain for joint exploitation and individual results) has been produced as well as a preliminary table of content regarding the **market analysis** has been drafted. Both documents will be at the core of a dedicated session to be organised in the framework of the M13 project meeting among ICONS, VTT and NEVS.

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Achievements and possible areas of concern

Within this first reporting period, the core dissemination formats (project logo, flyer and animation video) and channels (project website, YouTube account) have been launched to foster awareness upon DRIVEMODE innovation.

Deviations from GA

- The final release of the DRIVEMODE video has been delayed by about one month with respect to the foreseen timeline (M10) to ensure that all relevant messages and concepts are conveyed through the script and that the visual animations reflect it in a proper way.

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Publication Plan

Table 1 List of publications

Date	Authors	Title	Conference/Journal Details
16.10.2018	Paradkar M.	Electromagnetic Analysis of a high speed Induction Motor in an EV application using JMAG	JMAG Users Conference
9.10.2018	Nimananda Sharma, Yujing Liu	Multiple electrical machines applied for high drive train efficiency	International Conference on Electrical Systems for Aircraft, Railway, Ship Propulsion and Road Vehicles (ESARS) and International Transportation Electrification Conference (ITEC), Nov 2018

Table 2 List of planned publications

Date	Authors	Title	Conference/Journal Details	Lead WP
March 2019	Ronkainen H., Andersson P., Kilpi L., Högnäs T., Flink M.	Evaluation of DLC coatings for a high-speed e-mobility gear transmission.	Tribology International	WP6
January 2018	Paradkar M.	Design of High Speed- High Efficiency Induction Machines for EV Applications	JMAG Users Conference	WP3
November 2019	Tribioli L., Chiappini D., …	Novel control strategy for the cooling circuit of a high efficiency electric vehicle	TBD	WP5
2019	Nimananda Sharma, Yujing Liu	Modeling of converters for system simulation	TBD	WP2
2019	Nimananda Sharma, Yujing Liu	Optimal system design of multi-motor drivetrain.	TBD	WP2

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Conclusions

The status of the project is healthy, all tasks are executed according to the GA. Deep cooperation through various communication channels has been established between partners providing fruitful and flexible working environment. The project has gone through initial requirement specification, iterative concept design and selection phases, now detailed design of components and manufacturing processes are ongoing. In parallel, tasks related to testing specification and integration to the demonstrator vehicle are ongoing.

The project has communicated its results mainly through the website and LinkedIn group. In addition, partners have presented advancements on several conferences.

The usage of financial resources and working hours is reasonable and corresponds to the current state of the project. Slight deviation in timely submission of deliverables (on average 20 days) did not provide the impact on the project and proactive measures have been taken to eliminate this lag.

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Appendices

List of abbreviations

GA	grant agreement
WP	work package
FEM	finite element modelling
CAD	computer aided design
PMSM	permanent magnet synchronous machine

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