



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 768908



PROGRESS REPORT M30

DELIVERABLE D1.3

V.1 – NOVEMBER 2020

Status of deliverable: PUBLIC

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Deliverable Review and Approval

The individuals listed below are not directly involved in the preparation of this deliverable and will review/ have reviewed the current document.

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Deliverable Development and Review Process

	Key Event	Delivery Deadline	Actual delivery (Done by)
1	Submission of Internal Draft Deliverable to reviewers and uploading on Research Participant Portal	01/03/2020	2/11/2020
2	Initial Review and Comments obtained	10/03/2020	12/11/2020
3	Uploading of Final Deliverable on Participant Portal and submission	31/03/2020	14/12/2020

EXECUTIVE SUMMARY

This document reports briefly on the overall progress of project FreeWheel at month 30, specifying also technical, administrative and financial progress.

Overall progress

The project started October the 1st, 2017. The work packages active at the end of M30 are:

1. WP1 “Project Management” (M1-M36);
2. WP7 “FreeWheel integration and lifecycle distributed management and optimization” (M18-M36);
3. WP8 “FreeWheel demonstration” (M24-M39);
4. WP9 “FreeWheel dissemination and exploitation” (M7-M39);

WP2 “Human centred requirements and objectives” concluded at M12, WP3 “FreeWheel Product design concluded at M24, WP4 “FreeWheel service and digital touchpoints design” concluded at M29, WP5 “FreeWheel process design” concluded at M27, WP6 “FreeWheel product infrastructure” concluded at M25.

Technical progress

WP2 concluded with a definition of the design and functional requirements of the FreeWheel solution. This translated mainly in a definition of the technical and service delivery objectives which have informed the design of the FreeWheel product and service (WP3 and WP4). WP3 concluded the design of the motorisation solution comprehensive of sensing to aid autonomous drive, as well as on the engineering platform to be used to exchange CAD files on the solution itself. FreeWheel product includes commercial components and customised parts that could be made by Additive Manufacturing (AM) and 3DPrinting exploiting the experience and technological capabilities and facilities within the Consortium (WP5 and WP6). WP4 has been completed the main objectives. From the activity of WP2 and WP3, partners have designed and implemented the digital touch points for the efficient service provisioning, configuring the app to accompany the user during the FreeWheel experience. WP5 concluded with a short delay, due the sanitary emergency, in any case, the objectives have been achieved. Indeed, the involved partners identified and validated the AM processes that are necessary to satisfy personalization features. Moreover, the definition of CAx modelling and simulation platform, suitable for the business model integration of the production system, in accordance with the result of WP2.

In accordance with WP5, WP6 was completed with a series of manufacturing activities, which support the realization of the FreeWheel modules. Therefore, mechatronic equipment has been defined and integrated and a platform for automation and control has been developed.

At 30 months the activities of WP7, WP8 and WP9 are in progress (activities covered awareness raising initiatives including the set-up of @FreeWheelEU Twitter profile and undertook the first mapping off exploitable results.)

Administrative progress

The 30 months Review Meeting was held online on March the 25th 2020, where the Consortium presented the work done to date to the Project Monitor and the Project Officer. Deliverables expected have all been uploaded.

Financial progress

Project spent at M30 is configured as a 77% of total personnel cost and 54% of total “Other Direct Costs”.

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Introduction

This document reports on overall progress of project FreeWheel updating D1.2, covering the period March 2019 – March 2020 and analysing technical, administrative and financial progress.

The project started on October 1st, 2017 and it is at M30. The work packages active at the end of M30 are:

1. WP1 “Project Management” (M1-M36);
2. WP7 “FreeWheel integration and lifecycle distributed management and optimization” (M18-M36);
3. WP8 “FreeWheel demonstration” (M24-M39);
4. WP9 “FreeWheel dissemination and exploitation” (M7-M39);

WP2 “Human centred requirements and objectives” concluded at M12, WP3 “FreeWheel Product design concluded at M24, WP4 “FreeWheel service and digital touchpoints design” concluded at M29, WP5 “FreeWheel process design” concluded at M27, WP6 “FreeWheel product infrastructure” concluded at M25.

The partners are all fully cooperating to ensure the progress of the project, and the FreeWheel solution is taking shape both in terms of product (motorising solution) and service (users experience).

Technical content

WP2: Human centred requirements and objectives

The objective of this WP is the definition of the requirements for the whole FreeWheel system. It focuses on the identification of the design and functional requirements of the integrated solution. Some data about social behaviour, customer need etc. have been collected and analysed to obtain the specific design requirements.

The most important achievement is the establishment of a “Change Leadership Board” with complete oversight of introducing changes and evolving the Design Objectives and the Matrix. The members come from IRIS, SUPSI, Genny Angels, Keen Bull, and MCH. This board will meet regularly for evaluating and introducing changes and they relate to the WPs 3 and 4.

WP3: FreeWheel product design

The main objective of this WP focuses on the design of the FreeWheel mobility mechatronic solution consisting of the active module (the motor) and the customised connectors. A prototype of the solution was tested to validate the active system and to study the range of the battery pack installed to power the motor.

The solution is equipped with a wide range of sensors to enable the control of the motor and the stability of the system as well as to provide autonomous mobility functionality. Moreover, a set of RRP's have been developed to investigate the variability of available cases and which production technologies to use for the production. From the RRP's several geometric features have been associated to multiple manufacturing strategies, coherently with the available process technologies incorporated in the FreeWheel manufacturing infrastructures and assets, in a database.

A set of user-based and process-based KPIs have been determined such as quality, mechanical performance, and ergonomics but also throughput and costs

The Lifecycle Engineering platform is being developed and allows for the uploading, downloading and managing of the CAD files related to wheelchairs and FreeWheel solution accessories. The platform includes also a full 3D visualisation of the CAD files.

The achievements of this WP are represented by the MS3 and MS4. The first one is the design of modular and reconfigurable modules for the FreeWheel units presenting standard and interchangeable interfaces, and the second one is the validation of process chain. Both are better described in the related deliverables.

WP4 FreeWheel service and digital touchpoints design

The work package fulfils two main objectives: (1) designing FreeWheel service and (2) design and implement the digital touch points for the correct service provisioning.

The work package delivered the Service Design Challenges which are shaping the definition of the service. A blueprint of the service, i.e. a graphical representation of the relationships between different service components (people, processes), which are directly tied to the touchpoints, is being finalised, while the features of the digital touchpoint (the FreeWheel app) have been defined and are currently being implemented.

WP5 FreeWheel process design and WP6 FreeWheel production infrastructure

While the FreeWheel, product is being finalised in its first design, the Consortium has reviewed and shared the technical capabilities and facilities available. The WP5 and WP6 teams have built up during the years a wealth of experience in the application of Additive Manufacturing technologies, through design and construction of innovative equipment (e.g. H2020 project Borealis direct energy deposition machine) and study of process parameters to obtain a variety of features (thin walls, bored blocks, dense shapes) and functional parts (brackets and flanges). So the most important focus of this WP was the research of the appropriate strategy, equipment and process parameter to allow the manufacturing of the RRP, and the demonstration of the ability to easily produce custom components, with experimental DED production machines. Furthermore, commercial machines are available to cover the production of the FreeWheel demonstrators and trial the process and production chain which would be required to deliver a commercial product.

The team includes a specialist 3D Printing company who can build structural and non-structural components in a variety of materials including carbon fiber composites. The adaptive CAx design framework is under development and the aesthetic part design methodology was developed as well as a model based on RAMI4.0 applied to plastics supporting the 3D Printing activities undertaken.

The achievement of WP5 was the definition of the libraries for AM and technologies in deposition and ablation, moreover the realization of the RRPS. The description of the processes, technologies and results is reported in deliverables D5.1-D5.3

WP7 FreeWheel integration and lifecycle distributed management and optimization

At month 30 the activities are not yet completed, they will be completed at month 31, but most of the expected objective have been achieved, such as: the integration of the FreeWheel modules and sub-systems, the definition of multi-level optimization and adaptation strategies and increase the system responsiveness by persistently improving the efficiency, performance and sustainable behaviour.

WP8 FreeWheel Demonstration

The activity of WP8 will be concluded at the end of project, at month 30 only the virtual demo is made to evaluate functionalities, performance and benefits determined in cooperation with end-users. The virtual demonstrator of FreeWheel comprehended all the units' design aspects, from the mechanics, the electronics, the sensing and automation to the process and production logics and the optimization techniques.

WP9 FreeWheel Dissemination and Exploitation

Awareness raising about the project has continued with participation to a number of events (MEDICA in Dusseldorf, International Day of people with Disability in Lugano, specialised training events in Patras) and continuation and management of a FreeWheel project Twitter account. A number of scientific publications are submitted or planned, focusing on the field of Humanitarian Engineering, Autonomous Mobility and Additive Manufacturing. The participation to international conferences and peer-reviewed journals has been continued and planned for the next months of the project, as a possible dissemination outlet to reach the scientific and industrial community. With respect to the exploitation, work is being undertaken to develop the specification of exploitable results which will inform Milestone 13 and following work on this area.

Administrative Progress

A workshop about exploitation has been held in SUPSI (Lugano, Switzerland) on May 2019. Objectives were:

- Consider the different commercialization scenarios of the FreeWheel solution and set up the work to define the business plans
- Define the roadmap to commercialization: developing the solution from TRL7 to TRL9
- Membership of the Business Interest Group
- Actions to be taken for developing the exploitation plan of the results of the project

In September 2019, General Assembly took place in Monopoli (Italy). A first round of informal meetings involved the partners before the registration. During the assembly, the following aspects were faced: technical project status; administration and financial overview; WP3, WP4, WP5, WP6 progresses and results. In the last part of the meeting, it was checked the progresses and the plans of dissemination, industrial exploitation and communication activities. After introduction to the two demosites and the objectives of the discussion (what to demonstrate where, and when; information required from demosites; timelines etc), the assembly was concluded and followed by the visit to Morphica's facilities.

In March 2020, the review meeting was held online due to Covid-19 emergency. During the meeting, each partner shared the results achieved. Some of them were impacted on timing due to the health emergency. It seemed that the delay could bring to a project extension request, but it will not be requested until it will be clarified the development of Covid-19 diffusion. If the emergency and stoppages will continue, it will be asked the project extension to the EU commission. A constant discussion will be kept within partners to monitor project status.

Financial Progress

Project spent at M30 is configured as a 77% of total personnel cost and 54% of total "Other Direct Costs". The personnel expenditure is in line with the theoretical plan while the amount of other costs is as expected for a project delivering two demonstrators as final outcomes.

Conclusions

Project FreeWheel is progressing overall in line with expectations. With the finalisation of the definition of the FreeWheel product, the activities for its production – definition of process and definition of production infrastructure – are aligning, both for metal and plastic parts. The definition of the FreeWheel service is well underway and the accompanying app is currently being developed. A first map of exploitable results is under definition to develop a strong exploitation plan.

The fifth GA was managed in September 2019 and hosted in Monopoli (Italy), followed by Morphica facility visit. The last GA and project review will be held in September 2020 at the end of the project.