Deliverable 1.3

D1.3 Project Management Plan (PMP) Updated

Deliverable information	
Work package	[WP 1: Management]
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Reviewers	[Management Board]
Approval	[Management Board]
Status	[Final]
Dissemination level	[Public]
Will the data supporting this document be made open access? (Y/N)	[Yes]
If No Open Access, provide reasons	
Delivery deadline	[28.02.2022]
Submission date	[28.02.2022]
Intranet path	[DOCUMENTS/DELIVERABLES/]

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 821115

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Summary

This document is the third deliverable (D1.3) of the Project Management Plan (PMP), which is the updated PMP. The last version of the PMP was submitted as D1.2 in 2020. PMP reports are prepared by WP1 and reviewed by the Management Board. There will be one more PMP, which will be submitted in February 2023 and will focus on project closure.

PMP describes the tools needed for the execution of the project RISE, as well as establishes a roadmap for the implementation of the tasks in each WP. The PMP is the backbone of the project implementation, and aims to achieve the best quality of work while managing the time and resources efficiently. The project management pays special attention to the coordination of the work within the whole RISE community being carried out in a collaborative way. Therefore, the Work Package 1 (WP1) constructs a feedback mechanism between Work Packages that concurrently disseminates information and results. The PMP will support and enhance the cross WP/task collaboration as it identifies the various interconnections between tasks and subtasks within and across work packages.

The PMP deliverables that were submitted previously were structured in two parts. Part 1 (Project Management) and Part2 (Implementation Plan). Part 1 (Project Management) describes the general project management principles. To avoid duplication, in this deliverable we will skip the project management principles as they remain mostly unchanged. Part 1 of this report will provide an update on the deliverables, milestones, project meetings, risk register at M30 as well as a plan for the last project-year's meetings and activities. Part2 contains a detailed implementation plan, where we will only report changes if there are any compared to the previous PMP, and the work plan for the last year of the project.

Project Management

WP1 deals with project management and applies all the principles that were described in the previous PMPs. In this section of the report we will update the activities of WP1.

1.1 Update on deliverables & milestones

The procedure for the collection and approval of deliverables has been unchanged. The main responsible for each deliverable is sent a reminder at least 1 month before the deadline and is asked to submit the report 2 weeks before the deadline for internal revision. Upon green light by the reviewer, the RISE Project Office proceeds with uploading the document onto the EC portal. Table 1 and Table 2 show the timeline and status of the deliverables and milestones over the 42 months' project period, respectively. The green colour represents the timely submitted deliverables and achieved milestones. The yellow colour shows the submitted deliverable with slight delay and red colour shows delayed activities yet to be concluded in the final year of the project. The black marked milestones and deliverables correspond to the last year of the project and the plan for the timeline of these remain unchanged. Project Office follows the timely submission of the deliverables and milestones.

Table 1. Status of the RISE Deliverables

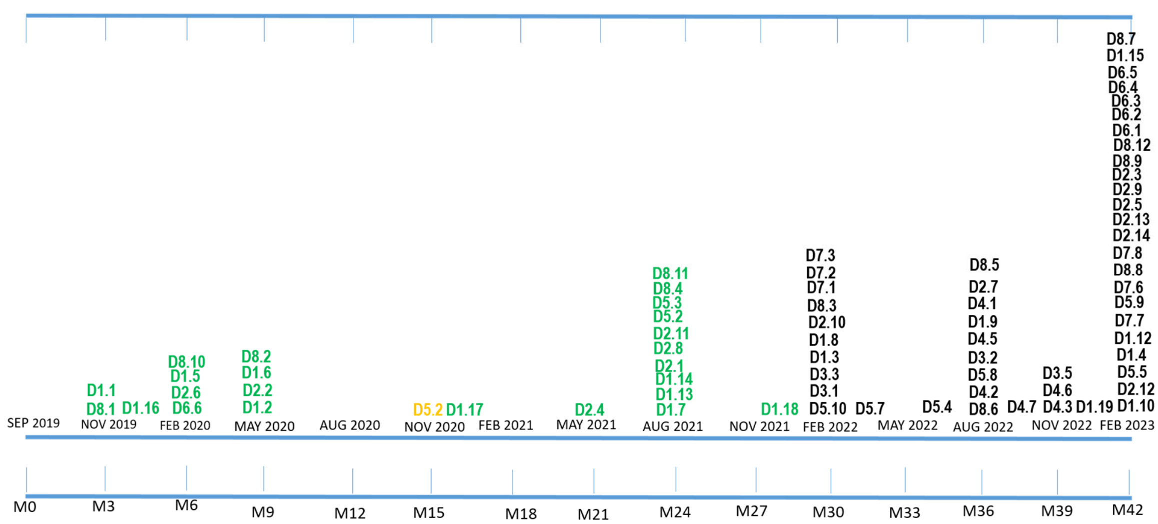
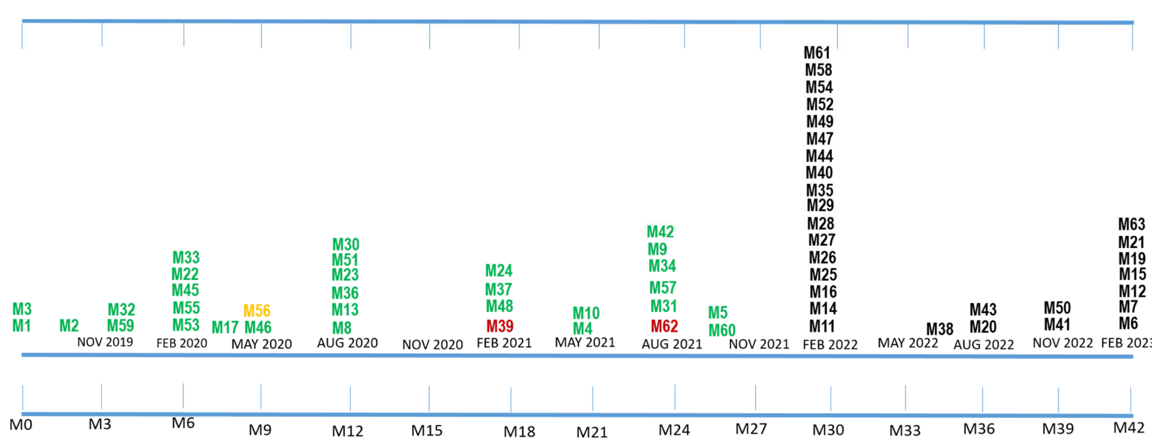


Table 2. Status of the RISE Milestones



1.2 Update on project meetings

WP1 organizes regular meetings at different levels as described in Task 1.6. We organize Project Meetings, Management Board Meetings and General Assembly Meetings, and regular scientific seminars. WP and cross-WP meetings are organized by the WP leaders, however WP1 provides support where needed. Meeting dates are decided by the Project Office based on the feedback collected from all members of the respective meeting using the doodle services.

Below is the updated list of meetings we had since the start of the project:

Kick Off Meeting: 2-4 Sept 2019

Mid-term Conference: 26-28 May 2021

Scientific Advisory Board Meeting: 17.12.2020 & 28.05.2021

General Assembly Meetings: 04.09.2019 & 28.05.2021

Management Board Meetings: 14 MB meetings have been held so far.

- 1st MB Meeting: 11.11.2019
- 2nd MB Meeting: 13.01.2020
- 3rd MB Meeting: 09.03.2020
- 4th MB Meeting: 11.05.2020
- 5th MB Meeting: 29.06.2020
- 6th MB Meeting: 09.07.2020
- 7th MB Meeting: 11.09.2020
- 8th MB Meeting: 11.01.2021
- 9th MB Meeting: 12.03.2021
- 10th MB Meeting: 01.07.2021
- 11th MB Meeting: 23.08.2021
- 12th MB Meeting: 27.09.2021
- 13th MB Meeting: 05.11.2021
- 14th MB Meeting: 17.01.2022

ZOOMing into RISE Meetings: 18 ZOOMing into RISE meetings

1. 02.07.2020(WP1)
2. 03.09.2020 (WP2)
3. 17.09.2020 (WP3)
4. 01.10.2020 (WP4)
5. 15.10.2020 (WP5)
6. 29.10.2020 (WP6)
7. 12.11.2020 (WP7)
8. 26.11.2020 (WP8)
9. 04.02.2021 (WP2)
10. 18.02.2021 (WP3)
11. 04.03.2021 (WP4)
12. 18.03.2021 (WP5)
13. 01.04.2021 (WP6)
14. 29.04.2021 (WP7)
15. 09.09.2021 (WP2)
16. 30.09.2021 (WP3)
17. 07.10.2021 (WP7)
18. 21.10.2021 (WP4)

Meeting Planning for M30-M42:

RISE Annual Meeting: 11-13 May 2022, Florence, Italy

RISE Final Meeting: January/February 2023

ZOOMing into RISE 2022: These seminars will restart in September 2022.

Management Board Meetings: MB meetings will continue as before, at least every two months.

1.3 Management of the Periodic Reporting

RISE Project Office coordinated the preparation and submission of the 1st periodic reporting, which covers the period 01.09.2019-31.08.2021. Guidelines on the financial and technical reporting as well as templates for financial and technical reporting were prepared and distributed to all RISE partners. The technical core report is being prepared as a joint effort by the whole consortium, regulated by the project office. The revision is done by the Management Board. The review meeting took place on 09.11.2021. Similar approach will be used to coordinate, prepare and submit the 2nd periodic reporting.

1.4 Update on Financial Management

The financial management of the project is conducted by the Coordinator and the Project Manager, as described in Task 1.1 of the GA. We monitor the distribution of the resources and budget, per WP and per partner. After the 1st reporting period, an overview of the claimed resources and budget versus the total budget is shared by the Management Board in order to do the necessary adjustments for the second half of the project. Table 3 shows the comparison of the direct costs (in Euros) and resources (in Person Month's – PM) allocated for the entire project, spent during year1 and year2 of the project. Overall, RISE has spent 63% of the resources and 58% of the personal direct costs during the M1-M24. Table 4 lists the budget use per partner for the M1-M24 period. In addition, we submit annually a cumulative expenditure report (D1.17, 1.18, 1.19), where all partners provide their financial expenditure. This will allow the partners to see if adjustments are needed to fit to the budget.

Table 3: Use of Direct Costs

	Direct Costs			PM
	Personal Costs	Other Costs	Subcontracting	
Grant Agreement	5,546,894	603,745	95,000	1096
Spent M1-M12*	1,685,407	139,578	0	316
% Spent M1-M12*	30%	23%	0	28%
Spent M1-M24	3,233,393	191,574	17,168	697
% Spent M1-M24	58%	31%	18%	63%

Table 4: Use of budget per partner

Partner	Total Spent M1-M24 (€)	Total Budget (€)	% Spent M1-M24
ETH	954454.71	1755000	54%
GFZ	322436.54	865000	37%
INGV	271928.66	420000	64%
IMO	34912.5	340000	10%
UNIBO	135679.15	225000	60%
UNIVBRIS	96860.64	250000	38%
UEDIN	291374.23	520000	56%
UNINA	490014.53	820000	59%
BIU	135888.74	225000	60%
EUCENTRE	371167.16	430000	86%
EMSC	328224.1	440000	74%
UGA	289982.87	380000	76%
UCAM	159592	300000	53%
BOUN	136775	300000	45%
KNMI	14656.13	50000	29%
UniBG	94025.18	150000	62%
UKRI	31809.76	60000	53%
QUAKE	223739.75	445000	50%
OGS	28961.33	46500	62%
TOTAL	4412483.03	8000000	55%

1.5 Update on Risk Register

The Management Board maintains a Risk Register that lists all the identified risks, a current assessment of the threats they represent to the success of RISE, the entities responsible for taking appropriate action, the potential action, and its current status. An updated risk register is shown below (Table…)

Risk number	Description of risk	Latest applied risk mitigation measures aplied (Deliverable 1.2 - 31 Aug 2020)	Risk mitigation measures (Aug 2021)
1	Technical risk -- Project duration of 3 years too short Potential Impact -- Failure to deliver in time and quality	MB monitors timely delivery implementation status. All tasks are performed in parallel.	Covid related extension request accepted by the EU. Project duration is now 42 months (see new item 12 below). Activities are on track. Quality checks are archived through a revision process before each submission by an experienced scientist, who is either the WP leader of the respective deliverable or another expert from the field.
2	Technical risk -- Dependencies too strong between WPs Potential Impact -- Delayed delivery in one WP hindering progress in other WPs	So far no interruptions due to dependencies are observed.The Implementation Plan supports the link between tasks and WPs. WP and joint WP meetings ensure the communication and coordination of inter-linked tasks.	WP2-3-7 teams work in collaboration. There were a number of joint WP2-3-7 meetings. WP5-8 teams work together and held joint meetings. WP4-6 dependincies are also well covered by WP6 leader being a task leader in WP4.
3	Financial risk -- Underestimation of required resources for scientific developments (medium) Potential Impact -- Scientific contributions fail to be integrated, tested or distributed	RISE project benefits from in-kind contributions where needed.	This risk is largely eliminated by many in kind contributions from RISE partners.
4	Financial Risk -- Available resources spread too thinly, with too many WPs and beneficiaries (medium) Potential Impact -- Failure in maintaining the planned workflow and timeline	RISE Office collects annual financial updates from all partners, to ensure the workflow , the timeline and the budget are maintained as planned.	RISE Office collects annual financial updates from all partners, to ensure the workflow , the timeline and the budget are maintained as planned.
5	Strategic risk -- Failure to integrate RISE services in EPOS (small) Potential Impact -- Long-term sustainability may not be achieved		EPOS Seismology leader joins RISE MB meetings, where needed. EPOS and RISE joint scientists work together for the integration as well as sustainability.
6	Strategic risk -- Disconnect between earthquake engineers & seismologist (small) Potential Impact	Regular WP and joint WP meetings are held.	ZOOMing into RISE seminars every two weeks since September 2020 allow seismologists and engineers come together and exchange ideas and discuss the overlaps.
7	Strategic risk -- Disconnect between natural scientists, social scientists and economists (small) Potential Impact -- Limited integration and reduced socio-economic impact	Regular WP and joint WP meetings are held.	WP5&8 had several joint meetings. Activities are well integrated.
8	Strategic risk -- Failure to timely identify and mitigate risks (small) Potential Impact -- Potential risks are discovered too late to enable efficient recovery	MB meets every 2-months and discusses the status of the WPs, the pending deliverables and milestones for the next months ahead, discusses any issues that may cause potential delays and ensures the timely implementation of the project.	MB meets every 2-months and discusses the status of the WPs, the pending deliverables and milestones for the next months ahead, discusses any issues that may cause potential delays and ensures the timely implementation of the project. The following risks have been detected, and measures have been taken: 1) IMO's lack of participation in certain tasks are determined in a timely way. Efforts have been made to involve them more in the project. Partly achieved with their participation in WP5, 8. Budget cut is considered for their lack of participation in WP6. 2) Quake Sensors: global chip crisis and its consequences The parties effected are informed, a new strategy for Quake's work in RISE is developed and distributed among partners.
9	Strategic risk -- Underestimate ethical or privacy related risks (small) Potential Impact -- Improper use of data and products, lack of acceptance.	We prepared a Data Management Plan (DMP)and submitted to the Commission as D 1.16, which sets the rules for data used and produced in RISE. DMP is shared by all RISE partners.	No concerns so far
10	Strategic risk -- Over- dependence on key individuals (medium) Potential Impact -- Lack of community building, poor involvement of partners	MB closely follows the proper involvement of all partners. Necessary actions are taken, when facing poor involvement of a RISE partner.	Poor involvement of one partner (IMO) determined. Efforts have been spent to involve them in the project. Despite all efforts their participation was limited. Corrective measures have been taken.
11	Strategic risk -- Reduced visibility and impact (medium) Potential Impact -- Failure in maximizing the impact	PEDR (D 8.1) listing the KPIs and the updated PEDR (D8.2) which lists the improvement of KPIs by time are submitted to the EC.	Visibility is achieved in various ways such as the RISE website, the external newsletters, participation in conferences, the peer reviewed publications etc. WP8 is updating KPIs regularly, that are then being evaluated by the MB.
12 New Added Risk	Covid 19 – Delay in certain tasks, milestones and deliverables due to lock-down period in 2020	6 months project extension is requested from the EU through an amendment.	6 months project extension is approved by the EU through an amendment. Deadlines of deliverables and milestones as well as periodic reporting are adjusted accordingly.

Implementation Plan

This section will provide second update to the original implementation plan, which was first updated in August 2020. To avoid duplicates, we will only emphasize changes of plan from the previous one if any, and we will plan the activities in tasks during the last year of the project. As WP1 deals with the project management, which is mostly covered in the first section of the report, we will not include WP1 in this section.

2.1 Work Package 2 – INNOVATION

"Exploiting innovation, technology advances and opportunities of big data for earthquake loss reduction"
Lead: UEDIN
Authors: Ian Main; Andreas Fichtner, Marius Isken, Erdal Safak, Lauro Chiaraluce, Laurent Stehly, Carlo Cauzzi, Alberto Michelini, Javier Quinteros, Danijel Schorlemmer

General Overview: The overarching aim of this work package is to assess and exploit the opportunities for innovation, technology advances and big data to improve Operational Earthquake Forecasting (OEF), Earthquake Early Warning (EEW) and Rapid Loss Assessment (RLA). These are disruptive new technologies and capabilities that together provide significant improvements to the technological basis for real time monitoring and earthquake risk reduction.
We address this in seven separate tasks as described below. The focus is on assessing, developing and testing the capability of the technologies listed to address the overarching goals of RISE. WP2 delivers input to all subsequent WPs, and is specifically linked to WP3 (earthquake forecasting), WP6 (WP7 (Forecast testing) by providing improved input forecast methods, primary waveform data, and earthquake catalogues, to WP6 (Pilot and Demonstration), where we will thoroughly optimise and test the technical innovations, and to WP8 (exploitation and dissemination).
In narrative terms we have delivered the following exploitable results:

- Proof of concept of DAS deployment in an urban setting and in challenging field environments
- New generation low-cost seismic sensors
- New seismic source generators for active testing of building response to strong motion, with proof of concept the signal can be detected through 15 storeys of a multi-story building, and that wave travel times can be measured
- New generation earthquake catalogues for Italy
- New method for data-driven optimization of seismicity models using diverse data sets
- Proof of concept seismic interferometry can detect very small changes in seismic velocity, at least for post-seismic stress relaxation
- Technical solutions for open, dynamic, high volume, scaleable, cloud-based European data archiving and provision services in anticipation of the explosion of data from existing and new technologies
- Models developed for the assessment of exposure to seismic risk at a street by street level, applied to San Francisco and Cologne

In the next year we will

- Report on all DAS field deployments (Deliverable D2.3)
- Deliver functional next generation sensors and hyper-dense networks and sensor (D2.5)
- Test the capability of our new eccentric mass shaker to excite the ground near buildings and hence determine soil-structure interaction (SSI) effects (D2.7)
- Make available a high-resolution, updated earthquake catalogue for the Italian peninsula to RISE partners, and two additional new catalogues to examine their potential for improving OEF during the earthquake preparatory phase (D2.9).
- Report on the temporal change the upper crust properties using ambient noise techniques (D2.10)
- Complete the technical development of prototype big data solutions (D2.12)
- Provide an assessment of the technology readiness and operational capability of big data solutions (D2.14)
- Make available an open, dynamic, high- resolution dynamic exposure model for Europe (D2.13)

Use of resources for WP2 is summarized in the table below.

Partner Name	**PMs Total**	**PMs Claimed in 1st RP**	**To be used in 2nd RP**
ETH	30	15	15
GFZ	30	14.05	15.95
INGV	43	31.69	11.31
IMO	6	0.64	5.36
UNIBO	16	13	3
UEDIN	20	7.63	12.37
UNINA	5	3	2
EUCENTRE	4	2	2
UGA	20	20.9	-0.9
BOUN	18	12	6
KNMI	3	1.62	1.38
UKRI	2	0.93	1.07
QUAKE	24	2	22
OGS	4	2.66	1.34
Total	225	133.12	91.88

2.1.1 Task 2.1: Utility and value of high-density DAS

30-month update: During the past 30 months, we successfully produced the deliverables D2.1.1 [Large-scale DAS logistic feasibility study on new applications] and D2.2.1 [Deployment of prototype array], thereby reaching the milestones M2.1.1 [Operational test of an experimental DAS array] and M2.1.2 [Deployment of experimental arrays, effects of coupling, instrument characteristics and detectability of regional earthquakes].

In particular, we conducted a detailed study on the broadband instrument response of Distributed Acoustic Sensing (DAS) arrays, through the comparison of multiple field experiments with co-located conventional seismic sensors. We came to the conclusion that DAS has a nearly flat instrument response between around 0.3 mHz - 1 kHz (Paitz et al., 2020). Furthermore, we successfully performed DAS experiments in challenging volcanic and glacial environments, which led to the discovery of previously unknown levels of seismicity and tremor (Walter et al., 2020; Klaasen et al., 2021, 2022). Urban DAS experiments in Bern (see earlier reports in Deliverables 2.1 and 2.2) and Athens provided large data volumes, containing rich information on shallow subsurface structure. The detailed analysis of these datasets is work in progress.

- Paitz, P., Edme, P., Gräff, D., Walter, F., Doetsch, J., Chalari, A., Schmelzbach, C., **Fichtner, A.**, 2020. *Empirical investigations of the instrument response for Distributed Acoustic Sensing (DAS) across 17 octaves*. Bulletin of the Seismological Society of America, doi:10.1785/0120200185.

- Klaasen, S., Paitz, P., Lindner, N., Dettmer, J., **Fichtner, A.**, 2021. *Distributed Acoustic Sensing in volcano-glacial environments – Mount Meager, British Columbia*. Journal of Geophysical Research, **126**, doi:10.1029/2021JB022358.

- Klaasen, S., Thrastarson, S., **Fichtner, A.**, Cubuk-Sabuncu, Y., Jonsdottir, K., 2022. *Sensing Iceland's most active volcano with a «buried hair»*. EOS, **103**, doi:10.1029/2022EO220007.

- Walter, F., Gräff, D., Lindner, F., Paitz, P., Köpfli, M., Chmiel, M., **Fichtner, A.**, 2020. *Distributed acoustic sensing of microseismic sources and wave propagation in glaciated terrain.* Nature Communications, **11**, doi: 10.1038/s41467-020-15824-6.

Plan for M30-M42: The only remaining deliverable in this task is D2.2.2 [Report on all DAS field deployments]. Reports in the form of journal publications already exist for the experiments on Mt. Meager, Rhôneglacier and Grimsvötn volcano, though the analysis of the latter can still be extended substantially.

Our plan for the remaining months is to intensify our work on the datasets collected in Bern and Athens. The analysis of the Bern data is nearly finished. It includes subsurface imaging using active sources (human jumps), anthropogenic noise correlations and reflected surface waves. The writing of a manuscript is work in progress. The Athens dataset is now being analysed together with various colleagues in Greece. It contains very clear recordings of local earthquakes, thereby offering the opportunity to study the ability of DAS to improve event location and characterisation. Furthermore, a local tomography using anthropogenic noise correlations is work in progress.

2.1.2 Task 2.2: Next generation sensors and hyper-dense networks

30-month update: QUAKE developed a cost-effective seismic sensor platform and management software as part of D2.4. The research and development of its feature and integration requirements were coordinated with project partners at ETH, ERI, ISTERRE, BOUN and Univ. Montenegro, leading to the design of two cost-effective Internet of Things (IoT) sensor platforms [Milestone MS10], namely (1) a cost-effective 20-Bit low-noise strong-motion seismic sensor for monitoring shaking intensities and acceleration waveforms in buildings, and (2) a modular seismic sensor platform with integrated GNSS and off-line quartz timing. The sensor can be equipped with different seismic instruments: short-period 24-Bit seismic sensors (coil inducers, own development), high-resolution accelerometers (QMEMS technology) or MEMS based rotational sensors. Further the modular design enables native connectivity over cellular networks and the integration of other connectivity modules (e.g. LoRaWAN or WiFi HaLow). The development of this versatile seismic sensors platform was driven by the identified requirements and specifications of RISE partners. The sensor is suited for both indoor and outdoor installations (with a waterproof IP65 case for outdoor use). The sensors are currently being tested by RISE partners in indoor and outdoor locations [MS37].

Alongside with the hardware developments QUAKE developed a modular sensor firmware and a scalable management back-end interface [MS11]. The sensor firmware is developed with reliability and maintainability through remote over-the-air updates in mind, following state-of-the-art concepts of software engineering. Further the sensor firmware enables the computation of meaningful high-level seismic data products on the instrument, e.g. PPSD, H/V ratios, single-station Green's functions or pre-trained neural networks for P-wave identification.

The developed back-end interface offers a central management console for real-time management of large fleets of QuakeSaver seismic sensors and the evaluation and analysis of seismic data products. Alongside with the innovative developments the sensors are compatible with established data exchange formats, i.e. SeedLink, FDSN Web services and MiniSeed to mesh with the requirements of Task 2.6.

Unfortunately, the global chip crisis led to critical shortages and unavailability of integral components in 2020/2021, thus only a small number of sensors were produced. Consequently, we focused our research on the development of PCBs and sensors software.

Plan for M30-M42: In the coming months we will focus on hardware manufacturing challenges, encouraged by the first signs of a relaxation of the chip crisis which to date has led to shortage of various integral components (e.g. Analog-digital-converter, MEMS accelerometer, SBC). We aim to deliver more seismic sensors to testing sites of RISE partners in 2022 [MS37].

Along with the delivery of seismic sensors we will fortify and 'battle-test' our software stack (firmware and back-end platform) and aim to release the developed software as an open-source resource for the wider scientific community. This will foster the development of real-time signal processing plugins which calculate high-level seismic data products on the sensor [MS11].

2.1.3 Task 2.3: Innovative portable excitation sources for field testing of existing and densely instrumented structures

An Impact Hammer and Eccentric Mass Shaker have been designed and built as portable excitation sources for building testing. Both are small enough items of equipment to be transported to different floors via elevators. The Impact Hammer is being used to identify the dynamic properties of each story in multi-storey buildings (as if each storey is a single-storey building) by moving the impact hammer from floor to floor and using the top over bottom spectral ratio of recorded accelerations. The details of the identification are presented in the following paper that is completed within the RISE project:

Çetin M & E Safak (2021) An algorithm to calibrate analytical models of multistory buildings from vibration records, Earthquake Spectra, 1–17, DOI: 10.1177/87552930211046969.

The Eccentric Mass Shaker is being used to identify modal frequencies of multi-story buildings. The shaker can give sinusoidal forces at a wide range of frequencies and force levels to buildings by adding or removing rotating masses.

Plan for M30-M42:

During the remaining time of the project, we will add a large base plate and anchorage sticks to the eccentric mass shaker, so that we can use the shaker to shake the ground near the building and find out if we can get any soil-structure interaction (SSI) effects on the building's vibrations. The forces that are generated by the shaker can be made very large, and we think it is possible to excite SSI for buildings on soft soil.

We will prepare a report summarising the properties of the test equipment, their usage, and practical aspects that should help in field tests. We will also prepare user manuals for both sets of equipment.

2.1.4 Task 2.4: Advancing observational capabilities 30-month update - Task 2.4.1 and 2.4.2

With the goal of generating a high resolution and updated earthquake catalogue of the Italian peninsula (CLASS 1.0), including homogeneous (local) magnitudes, we have been working on the computation of absolute hypocentre locations for (422,557) events that occurred in the study region in the time period between 1981 and 2018. Locations have been obtained by applying a non-linear inversion location method (NonLinLoc; Lomax et al., 2000) in a 3D regional velocity model (Di Stefano and Ciaccio, 2014). In a few regions the 3D model has a resolution that is too coarse, we filled these in with with-smaller scale regionalized 1D velocity models. To mitigate the oversimplification involved in assuming 1D models, we applied specific station corrections for all the available stations.

CLASS 1.0 is going to be distributed internally to the project at M30 and a first publication is currently in preparation (*A global image of the Italian seismicity from probabilistic location in 3D velocity models: the 1981-2018 catalogue of absolute earthquake locations - CLASS; D. Latorre, R. Di Stefano, B. Castello, M. Michele and L. Chiaraluce*).

Keeping CLASS 1.0 as a reference, we are generating a new catalogue composed of relative earthquake locations (CARS 1.0), retrieved by using the Double Differences (DD; Waldhauser and Ellsworth, 2000) location algorithm. We also generated a dataset of waveform cuts designed to perform both cross-correlation analysis that will allow us to include additional delay times in the double-difference relocation process, and local magnitude computation. We selected only the events in the 2007–2018-time window because the oldest data were not all recorded digitally. We included hypocentre, station location information, origin time, and P- and S- onsets in the waveforms' header, storing everything in an open access database, to favour different applications. An additional catalogue (HORUS; http://horus.bo.ingv.it/) for the Italian region from 1960 to the present, with homogeneous Mw magnitude (computed or derived from regressions) has been published (Gasperini et al., 2021; Lolli et al., 2020). The catalogue is updated in near real-time within a maximum of a week.

Template matching was run to search 8 years (2009-2016) of continuous data exploiting about 40,000 well-located earthquakes in Central Italy. Codes have been updated to improve the performance and scalability.

We participated in all the project meetings and we completed Deliverable 2.8 "Progress of new generation catalogues for public dissemination (R, PU)".

Plan for M30-M42

In the final year of the project, we will use the waveforms cuts database to compute the maximum amplitudes and cross-correlation analysis, allowing us respectively to calculate local magnitude for all the 2007-2018 earthquakes and improve relative arrival times measurements. These actions will allow us to relocate the events and then to release (CARS), a second catalogue of the Italian region with higher resolution in hypocentral locations for the digital era (2007-2018) and homogeneous in magnitude, in month M34.

Contemporaneously we will deliver the catalogue of the seismicity that occurred after the 2009 L'Aquila and before the 2016 central Italy, seismic sequence retrieved by our template matching approach. These catalogues will serve to investigate the impact of the improved catalogues in OEF during the earthquake preparatory phase (D2.9 - M42).

2.1.5 Task 2.5: Explore the use of ambient noise correlations to systematically monitor the temporal evolution of active faults

30-month update:

The aim of this task is to monitor the spatio-temporal evolution of the mechanical properties of the crust associated with seismic events and seismic swarms in order to better understand the seismic cycle and to look for possible precursory signals.

During the first months of the project, we gathered a large database of seismic noise records in Europe, that includes all stations publicly available through EIDA from 2010 to 2021 in Greece and Italy. This allowed us to reach the **milestone 2.5.1 "*Screening for ambient noise anomalies in test regions*",** where we developed a simple method to screen seismic noise records to look for unconventional signals that are neither earthquake or typical oceanic noise. This method will be useful to interpret our measurements of seismic velocity variations.

By developing efficient data processing tools that allow us to process several TB of data, we were able to systematically compute daily correlations between each pair of stations. We used this database of noise correlations to compute the temporal evolution of the seismic wave velocity in Italy, with a particular focus on the Amatrice/Visso/Norcia earthquakes sequence that occurred within the Apennines. We mapped the seismic wave velocity variations at different dates highlighting the effects of the Amatrice and Visso/Norcia earthquakes on the upper crust and the post-seismic relaxation with a sliding window of 2 months.

Our second main target is Greece and the Gulf of Corinth which is one of the most seismically active regions of Europe. We studied the evolution of the seismic wave velocity in the upper crust between 2015 and 2020. Over a large area of Greece, our measurements are dominated by seasonal changes related to environmental parameters. In order to distinguish the changes related to tectonic processes from environmental parameters we investigate the origin of these seasonal changes. We show that in the Gulf of Corinth, they can be explained by precipitation. This result remains to be generalised to the whole of Greece, in order to be able to study specifically the velocity changes associated with seismicity.

We are about to present this work in the report D2.10 Report on the temporal change of the upper crust properties using ambient noise technique.

Plan for M30-M42:

The next step is to integrate our results with the task3.1 *Exploring seismic and non-seismic precursory signals*. This requires distinguishing the velocity changes that are related to tectonic processes from those which are due to external forcings such as temperature changes and rainfall. Moreover, we need to be able to identify bias in the measurements that can be due to instabilities in the noise wavefield. Hence, we will do the following:

- We will explore the possibility of predicting velocity variations related to environmental parameters from weather data, in order to distinguish between velocity variations related to tectonic and environmental processes. Here, the long term objective is to establish maps showing the seismic wave velocity variations in Italy and Greece related to tectonic processes only. This is a key point to integrate our result within the task3.1.

- We plan to study the velocity variations associated with seismic events and earthquake swarms in the Gulf of Corinth. The objective will be to use the earthquakes themselves as a source of noise in order to attempt to measure seismic wave velocity variations at high temporal resolution resolution (<1 day) and see how these are related to the dynamics of the seismic swarms and the triggering of larger magnitude earthquakes (Mw>4).

2.1.6 Task 2.6: Strategies for scalability, high-volume data access and archival beyond existing waveform services, exploiting cloud-based services

30-month update: this task completed Deliverable D2.11 and the associated milestone in August 2021. ORFEUS also organised a dedicated community workshop on "New data types and communities" in November 2021, where the topic of integrating massive datasets (nodal experiments and DAS) in seismological archives was presented and discussed in detail by domain experts at GFZ and RESIF: see https://polybox.ethz.ch/index.php/s/amz698ookxu18cUv. Selected European data centers affiliated to ORFEUS continue to actively collaborate with IRIS and other agencies in the in DAS Research Coordination Network group (https://www.iris.edu/hq/initiatives/das_rcn).

Among the relevant publications of Task 2.6 are:

- Quinteros, J., J. A. Carter, J. Schaeffer, C. Trabant, and H. A. Pedersen (2021). Exploring Approaches for Large Data in Seismology: User and Data Repository Perspectives, Seismol. Res. Lett. 92, no. 3, 1531–1540, doi: 10.1785/0220200390.

- Michelini, A., S. Cianetti, S. Gaviano, C. Giunchi, D. Jozinović, and V. Lauciani (2021). INSTANCE -- the Italian seismic dataset for machine learning, Earth Syst. Sci. Data 13, no. 12, 5509–5544, doi: 10.5194/essd-13-5509-2021.

Plan for M30-42: since the completion of D2.11, the work continues at GFZ and INGV on behalf of ORFEUS on:

- implementing strategies and software tools for integration of massive datasets (https://git.gfz-potsdam.de/javier/dastools) in seismological archives at GFZ; the software tools are being improved to allow handling different DAS data formats; delivery in due time before the end of the project is expected;
- establishing a prototype infrastructure (SeiSpark) for archival, access and interactive processing of massive seismological datasets at INGV; the target infrastructure described in D2.11 has been procured and the hardware delivered to INGV; the hardware will be installed within the next weeks and in the following months the processing framework will be established, configured and tested, and becomes / should become available before the end of the project.

2.1.7 Task 2.7: Develop an open, dynamic and high-resolution exposure model for EEW, OEF and RLA based on crowdsourced big data

30-month update:

The server infrastructure and the algorithms for processing OpenStreetMap (OSM) building data have been set up and shared via GitLab repositories[1]. Full test exposure models for San Francisco, the Attica region (Greece) and Cologne have been generated. The Cologne test case has been published (Nievas et al., 2022). For the Attica case, several versions of the exposure model have been completed, with different improvements and upgrades, as new features have been implemented to the prototype code. For this case, the building completeness of OSM in Attica was manually assessed per zoom-level 18 Quadtile using the newly developed completeness web application (Clickpleteness). To increase the coverage of completeness estimates, an automated algorithm based on the comparison of OSM building footprints and the Global Human Settlement

[1] https://git.gfz-potsdam.de/dynamicexposure/rabotnik/rabotnik, https://git.gfz-potsdam.de/dynamicexposure/openbuildingmap/rabotnik-obm.

Layer has been implemented[2] and has been run for most of Europe. Prototype algorithms that combine the aggregated exposure model of the European Seismic Risk Model 2020 (ESRM20) with data on individual buildings from OSM have been implemented. A full production version of the algorithms that processes the ESRM20 exposure model to feed into the Global Dynamic Exposure (GDE) model is developed shared via Gitlab[3] and the implementation of the processing unit for vulnerability classification based on exposure indicators is under way. A calculator that is able to compute expected damage probabilities for exposure models combining building-type assets with aggregated assets is developed and shared via Gitlab[4].

Plan for M30-M42:

In the last year of RISE, we will complete the full GDE processing chain and provide a full model for all of Europe (D2.13). This effort includes the continuing development of the automated estimation of exposure indicators per building and their translation via mapping schemes to vulnerability classifications. Furthermore, work will continue on the integration/operationalisation of all components of the GDE processing chain: automated completeness estimates and their updating with new buildings added, extension of the remote-sensing-derived built-up area estimates for global coverage, development of aggregated exposure models to be included as sources in GDE, development of APIs to access the data products, and the development of a vector-tile-based web frontend to the GDE data, presenting aggregated data per tile as well as building-specific per building footprint. We plan on close coordination with WP4 and WP6 for providing access to the GDE model for Europe.

- Nievas, C.I., Pilz, M., Prehn, K., Schorlemmer, D., Weatherill, G. & Cotton, F. (2022). Calculating earthquake damage building by building: the case of the city of Cologne, Germany. Bulletin of Earthquake Engineering 20:1519-1565, https://doi.org/10.1007/s10518-021-01303-w.

2.2 Work Package 3: ADVANCE

"Advancing operational earthquake forecasting and earthquake predictability"

Lead: UNINA

Authors: Warner Marzocchi, Christophe Voisin, Paolo Gasperini, Antonio Rinaldi, Domenico Giardini

General Overview & 30M Update:

Use of resources for WP3 is summarized in the table below.

Partner Name	PMs Total	PMs Claimed in the 1st RP	To be used in 2nd RP
ETH	24	11.3	12.7
GFZ	22	4.55	17.45
INGV	8	6.79	1.21
IMO	8	0.32	7.68
UNIBO	18	29	-11
UNIVBRIS	22	5.35	16.65
UEDIN	30	34.24	-3.24

[2] https://git.gfz-potsdam.de/dynamicexposure/openbuildingmap/obmgapanalysis.

[3] https://git.gfz-potsdam.de/dynamicexposure/globaldynamicexposure/gde-importer.

[4] https://git.gfz-potsdam.de/dynamicexposure/globaldynamicexposure/loss-calculator.

UNINA	26	17	9
BIU	44	13.7	30.3
EMSC	0	3.48	-3.48
UGA	18	1.6	16.4
BOUN	2	12	6
UKRI	2	2.22	-0.22
Total	224	131.55	92.45

2.2.1 Task 3.1: Exploring seismic and non-seismic precursory signals

30-month update: Task 3.1 focused on the use of passive seismic to monitor the evolution of the brittle crust, especially in Italy, which is a priority target due to its extensive seismic network and the number of strong earthquakes it experiences. Capitalising on a new technique that was proposed to image and monitor the fluid movements in the crust (named CCW for Coherence of Correlated Waveforms), we have shown the existence of a very particular pattern preceding the large mainshocks of L'Aquila (2009), Amatrice and Norcia (2016). This pattern is made of successive perturbations that grow both in amplitude and pace until the mainshock. The duration of this pattern goes from 5-6 months (Amatrice) to 12 months (L'Aquila). In space this pattern develops up to 100 km before focusing progressively towards the future epicentral zone. Given the density of the seismic stations, we have shown the pattern to cover an area of 20x20 km2 on the very day of the amatrice earthquake. The mainshocks are followed by an opposite pattern, with perturbations that progressively decrease in pace and amplitude.

Interestingly, the technique and the tools developed to investigate the variations of the crust are able to discriminate between the post-seismic behavior of Amatrice and the precursor to the Visso and Norcia earthquakes. This technique has the potential to distinguish a scenario with one mainshock from a scenario with multiple large ruptures.

We have checked the consistency of the candidate precursor with other precursory observations reported for the Amatrice earthquake, namely geochemical variations in Arsenic and Vanadium that are provoked by deep CO2 intrusions. We have reported also the Radon anomalies preceding the mainshock. All these observations taken together bolster each other.

All these results are reported in deliverable 3.1. A publication is soon to be submitted to Science Advances.

Plan for M30-M42:

In the remaining year to come, the priority will be given to the broadening of the previous results through an investigation of all available years to look after false detections. The question is how many times do we observe this pattern and where and when it is followed by an earthquake or not.

A second track to be opened is how to recognize very early in time that a fault is going under this pattern, i.e. is soon to be producing a large earthquake. A possible answer comes from supervised

machine learning. The idea would be to teach a neural network with the features of either the raw seismic signal or the CCW measurement itself.
A third track is to begin to couple the CCW measurement with the probabilistic earthquake forecasting algorithms.

2.2.2 Task 3.2: Enhancing earthquake predictability

30-month update: We developed new forecasting models based on current seismicity and applied them and other models taken from the recent literature to areas with good seismic catalogue coverage (like Italy, California etc.) where they were not applied before. In some cases, we adopted an alarm based approach which is more useful to be used by civil protection services in real cases. We further developed some literature techniques (Molchan diagram and Area Skill Score) to compare the effectiveness of alarm based methods. In particular, we developed an original algorithm to forecast potentially destructive earthquakes (Mw5.0-5.5) based on the occurrence of strong foreshocks. We also applied the EEPAS forecasting model to Italy and compared its forecasting ability with those of the foreshock method and of standard ETAS models. For the comparison we used an approach proposed by Shebalin in which one of the models takes the same role of random occurrence in usual Molchan diagrams and all other models are referred to it. (to be completed)

Plan for M30-M42: We will continue with the development of further forecasting approaches and of methods to compare alarm-bases approaches. We also will try to define some standard prescription to be followed to submit new forecasting methods to independent prospective testing.

2.2.3 Task 3.3: A new generation of OEF models

30-month update:
This time period coincides with the preparation of the main deliverable of this task, i.e., the deliverable D3.3. “A new generation of OEF models”. The deliverable is planned to be delivered on time. The deliverable contains the link to the software repository where all models are submitted for the testing phase that will be carried out in collaboration with WP7 in the last year of the project. Besides the codes, the deliverable contains a brief description of all models. In summary, the set of models encompasses i) the tweaking of the existing best performing OEF models (different flavors of Epidemic-type aftershock sequence models); ii) the development of more refined clustering ETAS models with parameters varying in space and time, and including an innovative description of a time memory which is not included in classical ETAS model; iii) a simplified version of clustering models to be used in a wide range of cases, including the whole Europe; iv) an innovative time-independent model which is based on the Bayesian *inlabru* philosophy, i.e., a non-parametric data-driven earthquake spatial models; v) an innovative testable time-dependent models entirely based on continuum mechanics, which takes into account the physics of the rate and state and the coulomb failure function.

Plan for M30-M42:

In the last year of the project, the modelers will actively work with WP7 to assist the testing phase of their models. This includes the correction of possible errors in the software, modification of formats, contributes for the retrospective and prospective testing phase of the models. The main outcome of this year will be the setup of models for a new 5-year CSEP experiment in the Italian territory.

2.2.4 Task 3.4: Knowledge transfer from and to other scales

30-month update:

The work planned for this task ended with the delivery of the document D3.4. This deliverable describes the experiments conducted at the cm to decametre/hectometre scale that provide a fundamental understanding of physical processes leading to fracture creation and reactivation. The current development of monitoring techniques, including very sensitive earthquake sensors as well as deformation monitoring will allow scientists to significantly lower the completeness magnitude and hence bring potentially the OEF models to a new level. During the work made in this task two datasets at different scales have been prepared; these databases have been used to pave the way to suggest a possible way to the development of new OEF models that account for a more advanced physical understanding of the earthquakes processes.

Plan for M30-M42:

In the last year of the project the work planned in this task is devoted in exploring if and how the results obtained in the first part of the project can be used to set up innovative operational earthquake forecasting models.

2.2.5 Task 3.5: Incorporating expert judgment in earthquake forecasting for risk assessment purposes

30-month update:

The still ongoing pandemic affected severely the work planned in this task. For this reason, in the past we re-scheduled the delivery of the final document and the overall work time schedule. In fact, the work planned in this task is focused on defining procedures and guidelines to build representative hazard scenarios for the evolution of seismic activity, accounting for the geological context of the region, seismicity migration patterns, geodetic information, historical events etc. The definition of the scenarios is rooted in experts' judgment, whereas the probability of these scenarios has to be coherent with OEF outcomes obtained from models.

By definition, the achievement of this objective requires the physical meeting of worldwide experts that was not possible due to the ongoing pandemic.

Plan for M30-M42:

In the last year of the project we have just started organizing an international meeting to gather worldwide experts on OEF from different countries. The final goal is to describe how different countries introduce the experts’ opinion in OEF and try to define a first set of guidelines for future applications on OEF. All these outcomes will be described in the final deliverable that will be released after the meeting and just before the end of the project.

2.3 Work Package 4: EFFECTS

“Advancing loss and resilience assessment for earthquake early warning and operational earthquake loss forecasting”

Lead: UNINA

Authors: Iunio Iervolino, Helen Crowley, Eugenio Chioccarelli, Bozidar Stojadinovic, Eleni Chatzi, Erdal Safak, Banu Mena Cabrera

General Overview & 30M Update:

WP4 addresses risk and resilience analysis for earthquake early warning (EEW), as well as for short- and long-term risk management during and after seismic sequences. In particular, this WP will combine, in a rigorous probabilistic framework, the models developed in its tasks and/or in other WPs, for seismic risk and resilience management, considering a multi-hazard context. WP4 is well on track. More specifically, the following objectives have been achieved in up to M30 (for details, the reader is addressed to the task-specific sections):

- Databases of building exposure models for more than 40 European countries and of European capacity curves for about 500 building classes have been released;
- An upgraded methodology to account for seismic damage accumulation on the building portfolio in multiple mainshock-aftershocks sequences has been developing;
- Structural health monitoring (SHM) techniques have been deployed to develop damage-sensitive features that can be extracted from measured acceleration signals to detect onset of damage;
- A structure-specific EEW system, to be used together with SHM to update structural vulnerability, is under development;
- A framework to evaluate immediate-to-long-term benefits of risk mitigation actions was developed, with reference to EEW, rapid loss assessment and SHM.

Plan for M30-M42:

In the following the main objectives that WP4 is planned to achieve in the final part of the project are listed:

- improving spatial and temporal distribution of population in the exposure models;
- complete formalisation of operational earthquake loss forecasting for Europe;
- assessment of the reliability of SHM-based building tagging;
- operationalizing earthquake performance-based EEW (e.g., software development for existing buildings);
- the expenses and the expected performance of an EEW systems will be estimated via the final cost-benefit analysis framework.

Use of resources for WP4 is summarized in the table below.

Partner Name	PMs Total	PMs Claimed in the 1st RP	To be used in 2nd RP
ETH	33	16.9	16.1
GFZ	6	0	6
INGV	2	1.61	0.39
UNINA	50	33	17
BIU	8	3	5
EUCENTRE	38	31	7
EMSC	18	7.74	10.26
UGA	15	0	15
BOUN	18	12	6
KNMI	3	0	3
OGS	3	0.81	2.19
Total	194	112.06	81.94

2.3.1 Task 4.1: Exposure and Vulnerability for OELF and RLA and 2nd generation RLA service for Europe

30-month update:

The following activities have been completed at month 30, and have focused on providing time-invariant exposure and vulnerability models as well as a ShakeMap service for Europe:

- The database of building exposure models for 44 European countries initiated in the SERA project has continued to be developed and reviewed and has now been publicly released on both GitLab and Zenodo (10.5281/zenodo.4062044). These exposure models cover the number and economic value of residential, commercial and industrial buildings, as well as their occupants. A publication on the evolution of seismic design considered in these exposure models has been published in the Bulletin of Earthquake Engineering.
- Open source tools for disaggregating the aforementioned national exposure models to a higher level of resolution (necessary for scenario assessment) have been developed in collaboration with the Global Earthquake Model: https://github.com/GEMScienceTools/spatial-disaggregation
- A paper on the impact of exposure model resolution on European seismic risk modelling has been published in the Bulletin of Earthquake Engineering.
- A first database of European capacity curves, fragility functions and vulnerability models for over 480 building classes has been released on GitLab and Zenodo (10.5281/zenodo.4062410). These models were published in a conference paper (COMPDYN).
- Open source software to develop fragility and vulnerability models with the capacity curves has been tested and a manuscript has been published in the Bulletin of Earthquake Engineering.
- A selected set of capacity curves for European reinforced concrete building classes has been shared with Task 4.2 and checks on the resulting fragility functions with different methodologies/tools have been made.

- The European ShakeMap system prototype is up and running at http://shakemapeu.ingv.it. Among the developments carried out within RISE are: (a) the transition to the latest version 4 of the ShakeMap software that is optimally coupled with OpenQuake; (b) the development of a dedicated GUI by INGV that candidates as ShakeMap v4 community portal. The prototype European ShakeMap system uses the USGS ShakeMap codes and input from the ORFEUS RRSM and ESM strong-motion systems to deliver maps of expected and recorded ground shaking within minutes of any event with M >= 4.0 in the Euro-Mediterranean region. The predicted maps are initially constrained by the earthquake locations and magnitudes provided by Euro-Mediterranean Seismological Centre (EMSC) together with the recordings of the RRSM and subsequently updated as soon as manually revised ESM ground-motion estimates are available. The system uses the authoritative configuration for Switzerland and Italy and will in the future include any other regional configuration as adopted by other European institutions running USGS ShakeMap.
- EMSC felt reports have been tested by the United States Geological Survey by comparing 'Did You Feel It?' and felt report data at overlapping sites, and integration in the ShakeMap system is being considered. A paper on this work is in preparation.
- All of the necessary components of a European Rapid Earthquake Loss Assessment service have been completed - exposure models, vulnerability models, European ShakeMap system and risk engine (OpenQuake-engine), and thus milestone MS27 (RLA service for Europe transferred to WP6) has been completed by M30.

Plan for M30-M42:

The plans for M30-42 will focus on the dynamics of exposure models and introducing this within Rapid Earthquake Loss Assessment as follows:

- Task 2.7 is developing a Dynamic Exposure Model that is frequently updated using OpenStreetMap/OpenBuildingMap data. Collaboration with this task will intensify in this last period of the project to ensure that this individual building data can be combined with the statistical building data from the time invariant exposure models for 44 European countries (described above), and used within demonstrations of Rapid Earthquake Loss Assessment in Task 6.5.
- The spatial and temporal distribution of population in the exposure models will be improved using open data from the ENACT project (https://ghsl.jrc.ec.europa.eu/enact.php). Particular focus will be given to the variation of population during different times of the day and seasons.
- Scripts will be produced (and openly shared) to automatically adapt the population in the aforementioned exposure models following an event (based on the assessed damage states from a loss assessment, by correlating the damage state with the likelihood of evacuation). These scripts will be used to demonstrate these capabilities in WP6 in demonstration activities in Iceland and Europe.
- A workflow will be coded (and openly shared) to modify exposure models (accounting for damage accumulation) during sequences of events for use in existing open source software (OpenQuake-engine) and will be used in WP6 in the demonstration activities.

All of the aforementioned data, models and tools will be openly released as Deliverable D4.1 (Demonstrator: models for RLA service for Europe) and will be described in detail in the Deliverable D4.2 (Report: models for RLA service for Europe) at month 36.

2.3.2 Task 4.2: Improve and operationalize earthquake loss forecasting (OELF)

30-month update:

In accordance with the original work plan, Task 4.2 is improving of the existing system for operational earthquake loss forecasting that, in its current formulation, is not able to account for time-variant structural vulnerability. Thus, an upgraded methodology to account for seismic damage accumulation on the building portfolio subjected to subsequent seismic events is under development. Such a methodology, that will be described in the milestone named "OELF service for Europe transferred to WP6" (due on month 24), involves the concept of state-dependent fragility functions for building classes, that are identified, in turn, in accordance with Task 4.1. Thus, a close collaboration between Task 4.1 and Task 4.2 on this topic is ongoing allowing the computation of the state-dependent fragility functions for both reinforced-concrete and masonry Italian structural typologies. Indeed, although the methodology for OELF is, in principle, applicable at the European scale, the numerical applications and analyses will be produced referring to the Italian context.

Moreover, during the project, several discussions about the way in which data from structural health monitoring (Task 4.4, Task 6.1) can be fed to the system for OELF were done and a dedicated internal telematic meeting with all the involved partners was organised on 11/05/2021.

Within Task 4.2, the possibility of including time to recovery after seismic damage in the structural reliability models is also under discussion. This was the object of a presentation given during a special session named "Seismic Reliability Assessment" organised by the persons involved in the WP (E. Chioccarelli and P. Cito) at the 31st European Safety and Reliability Conference (ESREL2021) held in Angers (FR) at 19-23/09/202. In the same session, other works developed during the RISE project were also presented (by ETH and BOUN).

As a side results of the project, in Chioccarelli and Iervolino (2021) it was analysed the evolution of COVID-19 pandemic comparing with the death of rate in Italy estimated via the OELF system during past seismic sequences.

- Chioccarelli, Eugenio and Iunio Iervolino. 2021. "Comparing Short-Term Seismic and COVID-19 Fatality Risks in Italy." Seismological Research Letters.

Plan for M30-M42:

In the last year of the project, the following document must be completed:

Deliverable 4.2 - Operational earthquake loss forecasting for Europe (M33)

It will be completed in the due time. The object of the documents is also one of the topics of a PhD thesis that will be defended in the second half of 2022. It is developed in the context of the PhD course in Structural Engineering, Geotechnics and Seismic Risk at the University of Naples Federico II. A scientific paper will be also submitted on the same topic.

The plan for M30-42 will focus on the following activities:

- Complete formalisation of the analytical procedure;
- Definition of the algorithm to update the damage conditions of the building portfolio after each occurred event;
- Coding the MANTIS v2.0 software (WP6).

2.3.3 Task 4.3: Develop near real-time recovery forecasting for infrastructures

30-month update: Task 4.3. aims at predicting repair and recovery efforts after damaging earthquakes. The following has been achieved in the first 30 months:

- A recovery plug-in for recovery predictions based on OpenQuake scenario-damage calculations has been developed in Matlab. This plug-in simulates regional recovery based on the compositional recovery demand and supply (iRe-CoDeS) framework, which explicitly models limited supply of recovery services in the aftermath of damaging earthquakes.
- A framework for dynamic updating of shake maps and rapid loss assessment based on early inspection data has been developed. Machine-learning tools are leveraged to reduce uncertainty in predicted damage and its spatial distribution in a fraction of the time that would be required to inspect all damaged buildings (Bodenmann et al., 2021a, 2021b).
- Setbacks in recovery produced by aftershocks have been simulated and demonstrate that physical vulnerability of the built environment is dynamically influenced by damage and recovery.
- Post-earthquake recovery data has been gathered and predicted for the 2010 Kraljevo earthquake. This comparison serves as validation of the recovery simulator and as demonstrator of the flexibility to adapt to various post-earthquake recovery strategies.

- Bodenmann, L., Reuland, Y., & Stojadinovic, B. (2021a). Dynamic Updating of Building Loss Predictions Using Regional Risk Models and Conventional Post-Earthquake Data Sources. Proceedings of the 31st European Safety and Reliability Conference. https://doi.org/10.3929/ethz-b-000507866

- Bodenmann, L., Reuland, Y., & Stojadinovic, B. (2021b). Using regional earthquake risk models as priors to dynamically assess the impact on residential buildings after an event. Published Papers of 1st Croatian Conference on Earthquake Engineering, 1CroCEE, Zagreb, Croatia, March 22nd to 24nd, 2021, 71. https://doi.org/10.5592/CO/1CROCEE.2021.71

Plan for M30-M42: The following months will be dedicated to:

- Extensive testing and public release of a stable version of the recovery plug-in, OQ-RRE.
- Submit publications based on the work accomplished in the first 30 months.
- In collaboration with tasks 4.4 and 4.6 assess the resilience gain that can be achieved with large-scale sensor deployment.

2.3.4 Task 4.4: Advance technologies for data-driven SHM and damage detection

30-month update:
In task 4.4, structural-health-monitoring (SHM) techniques are employed to attempt automatic damage-tagging of building structures. A set of damage-sensitive features (DSFs) that can be extracted from measured acceleration signals has been developed to detect onset of damage. DSFs correlate with nonlinear indicators, such as hysteretic energy, which are indicative of the amount of nonlinearity a structure is exposed to and the related structural degradation. The correlation of DSFs with EMS-98 damage states, which could be the output of a visual inspection, requires model simulations, as shown for a simulated masonry building (Reuland et al., 2021). A methodology for using measurement data – collected during preparation work that preceded demolition – to reduce parametric uncertainty of such simulation models has been developed (Martakis et al., 2021) and applied to real measurement data of nine masonry buildings in Switzerland in order to compare updated predictions with typological capacity curves (Martakis et al., 2022).

Application of DSFs to three-dimensional models, shows that DSFs enable tracking the number of elements that are damaged, for instance spandrels and walls. This lays the foundation to correlate DSFs with repair and recovery efforts, established in Task 4.3.

In collaboration with task 4.2, the information retrieved from SHM that would enable data-driven selection of state-dependent fragility curves have been discussed and are currently implemented.

- Martakis, P., Reuland, Y., & Chatzi, E. (2021). Amplitude-dependent model updating of masonry buildings undergoing demolition. Smart Structures and Systems, 27(2), 157–172. https://doi.org/10.12989/SSS.2021.27.2.157
- Martakis, P., Reuland, Y., Chatzi, E. (2022). Reducing Uncertainty in Seismic Assessment of multiple Masonry Buildings based on Monitored Demolitions. Accepted for publication in Bulletin of Earthquake Engineering.
- Reuland, Y. , Martakis, P. , Chatzi, E. (2021). Damage-sensitive features for rapid damage assessment in a seismic context. Proceedings of the International Conference on Structural Health Monitoring of Intelligent Infrastructure (ISHMII), Porto, Portugal. https://doi.org/10.5281/ZENODO.5542288

Plan for M30-M42:

The final year of the project involves the following:

- Deliverable 4.5, which includes a demonstrator [YR1] [CE2] on near-real-time data-driven damage tagging of buildings after strong-motion excitation, will be compiled.
- A computational framework for automated post-earthquake tagging into global damage states, which may serve as input for state-dependent fragility (Task 4.2) and recovery efforts (Task 4.3), based on measured damage-sensitive features, will be developed.
- Reliability of SHM-based building tagging will be assessed and compared with the outcome from traditional fragility curves convoluted with either shake maps or intensity measures recorded at the base of an instrumented building.
- Improved community resilience from near-real-time building tagging will be assessed in collaboration with tasks 4.3 and 4.6.

2.3.5 Task 4.5: Improve and operationalize earthquake performance-based EEW

30-month update:

The objective of Task 4.5 is to develop location- and structure-specific Earthquake Early Warning (EEW) algorithms for buildings. Towards this objective, we have analysed acceleration data from five mid-size earthquakes (M>4.0) recorded at two instrumented high-rise buildings and eight EEW (Earthquake Early Warning) stations along the Marmara Sea near the faults in Istanbul. We have developed the attenuation relationships of the ground shaking parameters from each EEW station to the base of the one of the buildings, the Sapphire Building. The shaking parameters considered are:

- PGA - Peak Ground Acceleration
- PGV- Peak Ground Velocity
- SA02 – Spectral Acceleration at 0.2 second period.
- SA1– Spectral Acceleration at 1.0 second period.
- CAV – Cumulative Absolute Velocity
- Ia – Arias's Intensity
- SI _ Spectral (i.e., Housner's) Intensity

We have developed an analytical model of the Sapphire building from the recorded data by using the tools and techniques presented in the following two papers within the RISE project:

- Cetin and Safak, 2021. An algorithm to calibrate analytical models of multistory buildings from vibration records, Earthquake Spectra, 1–17, DOI: 10.1177/87552930211046969
- Caglar an Safak, 2021. Predicting Seismic Response of a Tall Building to a Large Earthquake Using Recorded Waveforms from Small Earthquakes, Proceedings, ESREL 2021 DOI: 10.3850/981-973-0000-00-0

We are currently studying the design calculations of the building to identify the threshold design values for the building.

Plan for M30-M42:

The following studies will be completed during the remaining of the project:

- By considering top story displacement, maksimum inter-story drift, and base shear as the critical response parameters, identify the critical ground shaking that will cause the critical response parameters to be reached.
- Identify shaking values at the EEW stations that will cause the critical ground shaking at the building base.
- Develop software to do these calculations.

2.3.6 Task 4.6: A user-ready risk-cost-benefit analysis framework for quantifying

So far we identified the following steps for a CBA:

1)Identification of risk mitigation assets/modules: EEW, OEF, RLA-w & w/o damage accumulation, RLA w SHM

2) Identification of the mitigation action (potential mitigation actions triggered by EEW, OEF etc)

3) Risk w/o the mitigation action in place – status quo

4) Expression of avoided losses, calculation of reduction in losses leads to analysis of risk reduction

5) Calculation of costs

6) Translation of risk reduction into money

7) Identification of net benefit or benefit to cost ratio

The abovementioned steps can be followed by OEF and EEW as their benefits directly involve mitigation actions, which can result in reduction of losses in some kind, that can be monetized. We also considered other RISE risk mitigation modules, where the benefits cannot be directly monetized. Below is a summary of CBA efforts for different RISE risk mitigation modules:

EEW & CBA

We have developed a framework to evaluate the performance and effectiveness of Earthquake Early Warning (EEW) systems in mitigating seismic risk. First, we determined warning time statistics by loss severity to assess the rate and consistency with which an EEW system could deliver timely alerts (Böse *et al.*, accepted). Then, we developed a Genetic Algorithm approach to optimize an existing sensor network by proposing sites for new stations in order to enhance its EEW performance in damaging earthquakes (Böse *et al.*, accepted). Finally, we assessed the plausible EEW-related reduction in losses (here: casualties), which is done by means of a logical framework based on literature-informed assumptions (Papadopoulos *et al.*, subm.). Risk estimates are then calculated assuming operation of an EEW system and compared to risk estimates in the absence of EEW. A preliminary assessment using this framework suggests that an EEW system in Switzerland has the potential to reduce average annual fatalities and injuries by ~1-8% and ~3-16%, respectively, depending on the selected target city.

We have now started expanding our framework by adding cost and monetary benefit estimates using the example of Switzerland. Both the expenses and the expected performance of an EEW system will be estimated for three build-out options (ranging from a low-cost demonstration to a high-cost fully operational system) and a roadmap for their realisation will be proposed. These costs will be contrasted with the expected benefits from personal action measures.

- Böse, M., A.N. Papadopoulos, L. Danciu, J.F. Clinton, and S. Wiemer (accepted). Loss-Based Performance Assessment and Seismic Network Optimization for Earthquake Early Warning, Bull. Seismol. Soc. Am.

- Papadopoulos, A.N, M. Böse, L. Danciu, J. Clinton, and S. Wiemer (subm.). A Framework to Quantify the Effectiveness of Earthquake Early Warning in Mitigating Seismic Risk, submitted to Earthquake Spectra.

OEF & CBA

ETH team has been working on ETAS models that provide forecasts for Switzerland that can be used as input for time dependent hazard and risk calculations. During the next phase of the project, hazard and risk calculation for Switzerland will be done. This will be extended to a CBA following already established methodologies by Dougles and Azarbakht (2020) and Hermann et al. (2016).

OELF & CBA

As pertaining to OELF, the identification of the best way to perform a cost-benefit analysis was a nontrivial task. As presented in a dedicated poster of the mid-term plenary RISE meeting, the cost-benefit analysis will be done comparing results of OELF provided by the original system with those obtained via the upgraded system developed within the project (Task 4.2). Indeed, the under-development new version of the system will be able to account for seismic damage accumulation of structural typologies due to subsequent earthquakes, an issue that is now neglected in the already available system. Thus, the costs will be quantified in terms of PM for developing the new methodology whereas the advantages will be quantified referring to past seismic sequences in which the effect of damage accumulation may have been significant. Such a WP has a strong relationship also with WP6.

- Selection of past seismic sequences to compare results of retrospective analyses performed via MANTIS-K and MANTIS v2.0 (WP6);
- Critical discussion of results and quantifications of the improvements reached via the upgraded system.

SHM & CBA

Cost-benefit of structural-health monitoring (SHM) is challenging due to the fact that better knowledge of the structure does not translate into a direct benefit. Therefore, a framework has been developed within Tasks 4.3 and 4.4, to simulate the recovery of communities impacted by an earthquake. This framework allows estimating time gain between current, inspection-based, assessment of structures and near-real-time building assessment based on SHM (developed in Task 4.4). Demonstrating time gain and critically assessing the reliability of SHM with respect to erroneous assessment requires large-scale simulations, which requires interaction with WP6. Unlike traditional fragility curves, SHM demonstrators would require dynamic time-history response simulations with shaking time histories at the base of several buildings. Simplified assumptions have been studied to enable such simulations.

CBA & Alternative Frameworks

Overall, while it is feasible and useful to use CBA as decision support, it is not straightforward to monetize the benefit of some of the risk mitigation assets. The question is then how such benefits can be quantified beyond money? Are there other frameworks that assess the usefulness of the value of information, a way of ranking? What kind of frameworks are good for assessing the usefulness of scientific information? In the next phase of the project, we will be focusing on frameworks, where alternative approaches to CBA such as surveys and expert opinion that could play a role in ranking/prioritising the different mitigation assets for decision support.

2.4 Work Package 5: SOCIETY

"Data Gathering and Information Sharing with the Public and Policy-makers"

Lead: EMSC
Authors: Remy Bossu, Alexandra Freeman, Michele Marti

General Overview & 30M Update:

The WP5 deals with interfacing seismology and society. It has 2 components, one on dynamic risk communication and one on citizen seismology. It aims at a) providing clear and accurate information to policy-makers and the public to enable strategic planning and appropriate preparation for seismic events, b) offering timely, appropriate information to a geographical area when the seismic risk rises and explore crowdsourced EEWS for global earthquakes and c) collecting large numbers of eyewitness observations, both direct and indirect, about the degree of shaking being felt and possibly the damage incurred. This, in turn, will improve rapid situation awareness and augment data at a relatively low cost.

The WP5 is well on track, the communication part being in line with the plan and the citizen seismology having already exceeded initial expectations. No challenges are identified for the last year of the project.

Use of resources for WP5 is summarized in the table below. UCAM's time was to be split across other work packages but has ended up being concentrated more on WP5 than anticipated.

Partner Name	PMs Total	PMs Claimed in the 1st RP	To be used in 2nd RP
ETH Zürich	18.00	28	-10
INGV	1.00	0.67	0.33
UNIBO	6.00	1	5
UNINA	1.00	1	0
EMSC	32.00	29.31	2.69
UCAM	24.00	33.78	-9.78
UNIBG	20.00	9.39	10.61
Total	102.00	103.15	-1.15

2.4.1 Task 5.1: Dynamic Risk Communication

30-month update:

Work started with a review of dynamic risk communication from a range of other fields (such as storm and weather forecasting, epidemiology and finance) as well as seismology, which resulted in deliverable D5.1.1. This included not just a review of published literature but findings from interviews with experts in different fields, and helpfully outlined the current state of knowledge in how to approach some of the most difficult aspects of Operational Earthquake Forecasting (such as communicating the very low probabilities and large uncertainties).

In order to understand the needs of OEF in the countries chosen (Italy, Switzerland and Iceland), we then undertook a series of interviews with members of the public, seismologists, emergency responders, the media and decision-makers to understand the current communications pathways used for different kinds of seismic information in these three countries. This helped us map the different pathways, and understand who needed what information, when, in what format, and to make what kinds of decisions. This was summarised in deliverable D5.1.2. This includes a set of interviews done in person on the streets of Italy in areas of different seismic hazard, which helped us understand the differing levels of risk perception and emotional reactions of those exposed to, and having experienced, different kinds of seismic activity.

To work on practical OEF communication we then embarked on a user-centred design process with members of the different audiences (and providers of the information), testing and iteratively refining potential OEF dashboards. This has taken, so far, 95 individual semi-structured interviews (at least 1hr long), and 6 focus groups. The findings of the first 65 interviews and the focus groups were reported in deliverable D5.1.3. We are currently analysing the final 30 interviews in order to produce a version of the proposed OEF website.

Plan for M30-M42:

Once analysis of the interviews we have conducted is complete, we plan to run at least three quantitative surveys in different countries which will help us gain a benchmark of risk perception and preparedness (and what individual factors might influence that, such as seismic experience, sex and age), and then test in a quantitative fashion, some of the materials we have developed for the communication of earthquake forecast information. For example, the effects of using different numerical formats, graphical aids, and contextual information on the perception of the risk being communicated. The protocol for this formed milestone MS31, and the results will form D5.1.4. We will also deliver the working website, which is designed to be able to take an OEF feed from any country and communicate it using the formats that we have iteratively designed and empirically tested during RISE alongside the good practice recommendations report, deliverable D5.1.5. The overall result will be an evidence-based communication system designed using best practice mixed-methods research, hand-in-hand with the end users, and which will ready to be implemented in a range of different countries.

2.4.2 Task 5.2: Crowdsourced EEWS and RIA

30-month update: In the first 30 months, the achievements were beyond the initial expectations. For example, for the crowdsourced earthquake early warnings, only a demonstrator was expected by the end of the project (D5.9) while actually the services are operational and fully demonstrated. The same applies to the near real-time estimation of earthquake parameters (D5.8), this service is currently in its final steps of validation and its integration with EMSC's operational services is planned for 2022. There are a number of activities, results and external collaborations which were unplanned but which reinforce the long-term impact of the RISE project. This includes a methodology for integrating EMSC felt reports with ShakeMaps developed with the USGS and which will likely be used for the European ShakeMap service as well as within several national institutes. Continuing with the scientific utilisation of felt reports, there is the determination of rupture geometry of large earthquakes using the FinDer software developed by ETHZ and also the virtual reconnaissance of the damage related to the 2020 Zagreb earthquake based on geo-located pictures crowdsourced by EMSC (with Newcastle University). Finally, we are also extending the work on the near real time estimation of earthquake parameters by testing the addition of raspberryshake data (data from citizen sensors). The success of these activities is reflected by the number of published papers (10 published, 1 submitted, 2 in preparation).

Plan for M30-M42: During the next period, 3 deliverables have to be delivered. The one (5.7) on the detection of landslides is well advanced and we will go beyond a simple report towards at minimum a demonstrator and possibly an open prototype service. The deliverable (5.8) about the rapid determination of source parameters was supposed to be a demonstrator, the demonstrator is in place and we are working on making it a fully operational service and to integrate it in EMSC operational services. Practically, we are working on 2 services, one exploiting the global seismic stations available in real time and another one where data from RaspBerryShake citizen sensors are added to these seismic stations. The idea is to evaluate the scientific benefit of these citizen sensors and potentially improve service performances. Finally the D5.9 was supposed to be a demonstrator of crowdsourced earthquake early warning, the service is already in operation, its performances demonstrated and we will keep improving it until the end of the project. As indicated by the reviewers, the citizen seismology has overused its resources, but rather than a sign of problems it is the price of its success and by moving towards services rather than reports or demonstrator, it ensures the long term impact of the RISE project.

2.4.3 Task 5.3: Improving earthquake information in a multi-hazard context

30-month update: In the first 30 months of the RISE project, the group at ETHZ has conducted in total four studies addressing the overarching research question: *How should the communication of event-related earthquake information in a multi-hazard context best be designed to increase society's resilience?* To this end, we used a transdisciplinary research approach to ensure that the communication products are based on latest research findings and fulfil the needs of the end-users, in our case the general public. Additionally, the combination of quantitative and qualitative methods allowed us to set a major emphasis on user requirements driving technological developments. Four overall conclusions of our research efforts are:

1. Multi-hazard platforms, if designed appropriately, can increase society's resilience toward earthquakes and other (natural) hazards.
2. The information on hazard overviews and messages on multi-hazard platforms must be actionable, by for example adding an icon- and time-related icon.
3. Multi-hazard platforms should be part of a broader communication network (multi-channel communication strategy) to ensure that as many people as possible receive the information.
4. Interactive features on multi-hazard apps increase people's ability to handle an emergency situation, i.e. sharing feature to inform further persons, an "I am safe" button to communicate that everything is fine, or a chat forum to build a joint understanding of what has happened.

Further general and (design) specific recommendations are summarised in D5.10. The scientific impact of this task is reflected by the number of published papers (2 published, 1 submitted) and a resulting doctoral thesis.

Plan for M30-M42: A package with measures was already sent to the institutions in charge in Switzerland and they will implement the adjustments in 2022. Further, we will continue the work on event-related communication in a multi-hazard context in particular on social media as part of the Horizon-2020 EU project CORE (sCience& human factOr for Resilient sociEty).

2.4.4 Entire Work package effort: How to fight earthquake misinformation?

In addition to the work done in each task, we together with international colleagues initiated and have worked on a RISE-TURNKey joint project with the aim to derive recommendations on how to prevent and fight misinformation about earthquakes. To this end, we first conducted a literature review and expert interviews, which allowed us to define the most common earthquake myths. Afterwards, we assessed the scientific consensus on the accuracy of each myth by conducting a survey with earth scientists. We used these insights and our expertise to compile a communication guide that will help institutions, practitioners and other actors communicating earthquake information to prevent and fight earthquake misinformation. The communication guide will be publicly available by the end of February 2022. Further, we will publish a RISE Good Practice Report and an opinion piece in the Seismological Research Letters on this issue, stressing the relevance of actively preventing and fighting earthquake misinformation.

2.5 Work Package 6: DEMONSTRATION

"Demonstration: Pilot and demonstration sites for RISE technologies and methods"

Lead: EUCENTRE

Authors: Helen Crowley, Cecilia Nievas, Eugenio Chioccarelli, Iunio Iervolino, Kristin Vogfjord, Stefan Wiemer

General Overview & 30M Update:

This WP focuses on demonstrating the research undertaken in work packages 2, 3, 4 and 5. The WP is divided up into 5 tasks. The first task (6.1) deals with applications at the building/city scale, the second, third and fourth (6.2, 6.3 and 6.4) are at the country scale and cover Italy, Iceland and Switzerland, respectively, and the last task focuses on the European scale.

In the first 30 months of this project there have been some challenges in WP6 related to difficulties in manufacturing the low-cost sensors (due to the global chip crisis - see Task 2.2) which has meant that the installation of sensors in buildings (Task 6.1) has been delayed. Despite these delays, some sensors have been installed, but some partners are having difficulties setting them up in the case study buildings, but they are working with QUAKE to resolve these issues. In addition, these partners are also making use of existing instrumentation in those, to be able to demonstrate the role of sensors in OELF, RLA, EEW and SHM. Delays in the activities of WP6 have arisen due to the limited ability of the Task 6.3 lead (IMO) to execute the planned project activities, leading to the delay in two milestones (MS39 and MS40). A plan has now been made to transfer part of the activities (and associated funding) to ETH, GFZ and EUCENTRE, as described in more detail below.

Notwithstanding these challenges, the WP has made a number of achievements, with milestones MS37 and MS44 now achieved, one deliverable submitted (D6.6) and significant advances having been made towards the remaining 5 deliverables, which are all due at month 42. The last 12 months of the project will see a significant focus in WP6, now that the research activities in the other work packages are well established and ready for implementation and demonstration.

Use of resources for WP6 is summarized in the table below.

Partner Name	PMs Total	PMs Claimed in the 1st RP	To be used in 2nd RP
ETH	20.5	12.21	4.79+3.5
GFZ	22	0	22
IMO	7.04	3.14	3.9
UNINA	20	13	7
EUCENTRE	31.5	25	3+3.5
EMSC	4	0	4
UGA	9	0	9
UCAM	6	0	6
BOUN	9	6	3
QUAKE	13	0	13
Total	142.04	59.35	82.69

2.5.1 Task 6.1: Pilot projects for demonstrating the use of innovative technology in buildings to support OELF, RLA, performance-based EEW and SHM

30-month update: Achievements so far, per sub-task:

- 6.1.1: Milestone 37 achieved in February 2021. Further sensors distributed by QUAKE since then: (a) 6 QUAKE tri-axial MEMS accelerometers successfully installed in two buildings in Montenegro by CF-UCG; (b) 6 QUAKE tri-axial MEMS accelerometers received by UGA; (c) 5 QUAKE tri-axial MEMS accelerometers received by BOUN. SED-ETH carried out tests on five first-generation QUAKE MEMS sensors in September 2020, which led to QUAKE carrying out modifications in hardware and software.
- 6.1.2: GFZ has carried out an exploratory study to analyse the use of a Naïve Bayes classifier for the prediction of a building's structural material based on knowledge of its number of storeys and first natural period of vibration. A report will be written between M30-M42.
- 6.1.3: A series of meetings have been held jointly with Tasks 4.2, 4.4 and 4.6 to define the connection between SHM and state-dependent fragility models. A meeting with Task 3.3 was held to make the connection with the next-generation OEF models. Integration with Task 2.7 is facilitated by GFZ leading the implementation of both tasks.
- 6.1.4: UGA has conducted successful experiments on the Grenoble City Hall using the permanent instrumentation of the building (Guéguen et al., 2021).
- 6.1.5: BOUN has calibrated a computer model of the Sapphire building using records from five mid-size earthquakes (obtained from their force-balance instruments). A methodology to predict the response to a large earthquake by extrapolating responses from small earthquakes has been developed and published (Caglar & Safak, 2021).

Plan for M30-M42: The following activities will be carried out within each sub-task:

- SED-ETH will continue to perform characterisation of the 130-m high Prime Tower building in Zurich, and additionally test how a single roof station equipped with novel instrumentation - inertial accelerations, fibre-optic gyroscope rotations, and GNSS displacements - can be used to fully characterise natural frequencies and identify mode shapes.
- 6.1.3 & 6.1.4: GFZ (as task leader) will keep on working jointly with the leaders of Tasks 3.3, 4.1, 4.2, and 4.4 to integrate the different components of this proof of concept. A large inter-task meeting will be held in M31-M32. Intensive data exchange, prototype implementations, building of the whole chain to take place.
- 6.1.4: UGA will apply machine learning techniques to sensor data from the Grenoble City Hall for operational-modal-analysis-based damage/anomalies detection, integrating the variation of the modal parameters with the effects of external forcing (e.g., weather conditions). UGA plans to compare the performance of measurements from optical fibre, laser and MEMS for Operational Modal Analysis and SHM.
- 6.1.5: BOUN will illustrate the capabilities of performance-based EEW systems by applying the methods and correlations between building and station parameters developed in Task 4.5.

- 6.1.6: GF-UCG will monitor the QUAKE sensors and analyse their recordings for the Budva building; obtained results will be integrated into the nonlinear model of the building with the aim of analysing modal responses and their variations for the potential full integration into a SHM system. The elongation of natural periods of vibration and damage indices will be investigated.
- 6.1.7: UGA plans to install the QUAKE sensors at the Grenoble City Hall building and carry out an analysis of QUAKE MEMS performance compared to that of force-balance accelerometer sensors. BOUN plans to (i) compare the five received QUAKE sensors against their own force-balance sensors on the shake table; (ii) use top-over-bottom spectral ratios of vibration records obtained by moving the QUAKE sensors across floors and using the impact hammer to identify the dynamic properties of each storey of the test-case building (methodology published in Çetin & Şafak, 2021).
- Final report (Deliverable D6.1, due month 42) will be written.

- *Caglar, N.M. and Safak, E. (2021). Predicting seismic response of a tall building to a large earthquake using recorded waveforms from small earthquakes. Proceedings of the European Safety and Reliability Conference, 19-23 September 2021, Angers, France.*
- *Çetin, M. and Şafak, E. (2021). An algorithm to calibrate analytical models of multi-story buildings from vibration records. Earthquake Spectra, doi: 10.1177/87552930211046969.*
- *Guéguen, P., Guattari, F., Aubert, C. and Laudat, T. (2021). Comparing direct observation of torsion with array-derived rotation in civil engineering structures. Sensors, 21(1), 142, doi: 10.3390/s21010142.*

2.5.2 Task 6.2: Demonstrating OELF at regional and national levels: Europe and Italy

30-month update

In accordance with the original work plan of the project, one of the activities of this task is to develop a demonstration of the OELF methodology developed in Task 4.2. To this end, state-dependent fragility functions for Italian building classes of reinforced concrete and masonry buildings were computed. Some of the resulting fragilities are discussed in Orlacchio et al. (2021). A complete description of all the developed fragility models for Italy will be part of a PhD thesis developed in the context of the PhD course in Structural Engineering, Geotechnics and Seismic Risk at the University of Naples Federico II. Possibly, a scientific paper will be prepared on this topic. Moreover, to allow the complete implementation of the OELF procedure accounting for structural damage due to occurred events, the system has to account for recorded ground motions in the whole area of interest. Thus, information from recording networks and shakemaps have to be considered, in a consistent way. Such a topic was discussed in a ZOOMing into RISE meeting (21/10/2021) and it will be the object of a scientific paper to be submitted.

- *Orlacchio M., Chioccarelli E., Baltzopoulos G., Iervolino I. (2021). State-dependent seismic fragility functions for Italian reinforced concrete structures: preliminary results. Proceedings of the 31st European Safety and Reliability Conference – ESREL 2021.*

Plan for M30-M42

The deliverable entitled “Report on testing OEF and extending earthquake forecasts to loss forecasts in Italy” is due at month 42. So far, no reasons for delays in the preparation of the deliverable have been identified.

The plan for M30-42 will focus on the following activities:

- Definition o1
- Coding of the MANTIS v2.0 software;

- Selection of past seismic sequences to compare results of retrospective analyses performed via MANTIS-K and MANTIS v2.0;
- Critical discussion of results (in collaboration with Task 4.6).

2.5.3 Task 6.3: Application of the chain from earthquake predictability to EEW and RLA in Iceland

30-month update:

Progress on Task 6.3 has been delayed due to the limited ability of the task lead (IMO) to execute the planned project activities. In particular, the following milestone has been delayed: MS38: Updated EEW capability in Iceland operational, due 28/02/2021. IMO faced staff shortages and over commitment, and was not able to hire a postdoc for a long time, in addition, earthquake swarms, volcanic eruptions and COVID in Iceland in the past 24 month have been challenging IMO staff. Task 6.3 is a demonstration task, which also brings together IMO’s other contributions in WP2 and WP3, which are consequently all behind schedule.

The RISE General Assembly, together with the Management Board, have discussed and proposed mitigation actions several times. It was decided at the GA in 2021 to allow other partners of the project to support these demonstration activities in Iceland during the second reporting period. Since then, IMO has made substantial progress in implementing the activities, as summarised below. The planning summarised below will ensure that the activities of this task will be completed by the end of the project and have a lasting impact in Iceland:

- IMO has worked in the context of RISE on earthquake crises in the Reykjanes peninsula, including fault and dyke mapping through eq. relocations, stress mapping and strain-rate mapping using GPS and InSAR, related to the volcano tectonic event going on there since 2019 and is still on-going (work related to WP2). IMO’s contributions to a Nature paper (which acknowledges funding from the RISE project) have now been sent back to Nature after responding to reviews. This has ensured that MS40 (Improved observational capabilities operational) has been reached on time (28/02/2022).
- IMO has been able to hire staff and is also making use of collaborations with post-docs from other projects to advance the activities related to OEF in Iceland. In particular, IMO has been working towards building critical mass on earthquake forecasting in Iceland in order to be able to sustain earthquake forecasting in Iceland in the long term, even after RISE ends. IMO submitted a postdoc application in 2020 on operational earthquake forecasting to the Icelandic research fund. The proposal was funded and a postdoc was hired on the project. The project started October 1 2021 funded for 12 months. The post-doc has been working at IMO and will continue throughout her project. This work is directly linked to IMO’s task in WP3 and a paper is submitted from this work (which is in final reviews at GJI) and RISE contribution is accredited.

Plan for M30-M42:

In the summer of 2021 IMO was recently informed that it would be funded for additional 12 months by the Icelandic research fund, therefore the work in OEF will continue. The work will be focusing on ensemble forecasting tests to be implemented for Reykjanes peninsula within the RISE project.

Given the short time available until the end of the project, and the need for more capacity building on OEF in Iceland, it is planned to transfer a proportion of the WP3/WP6 activities and funding to ETH (who have significant experience in OEF and OELF and also are actively operating seismic stations in Iceland) to ensure that the activities related to testing existing and new OEF models can be delivered by the end of the project. ETH is calibrating a new generation of ETAS models, for Europe, Italy, Switzerland and can do similar for Iceland with the contributions from IMO. It would be at least an alternative to compare IMO models. Likewise, GFZ will consider testing these models in WP7. GFZ is now building the testing experiment for Italy. This experiment can be used by the Iceland group to adapt to the Iceland experiment, with the help of GFZ.

Additional activities and funding will also be transferred to ETH for the work on enhancing EEW capabilities in Iceland. There are tools that can be adopted/transferred to Iceland, and ETH staff working on EEW will support the work in Iceland. This will ensure that milestone MS40 (Updated EEW capability in Iceland operational) can be reached, though with some delay with respect to the original deadline in the Grant Agreement.

Additional activities and funding will also be transferred to EUCENTRE to ensure that a Rapid Loss Assessment capability can be installed in Iceland. EUCENTRE will run some scenarios for RLA in Iceland using European models.

All of the above will be included in Deliverable D6.3 (Report on the Iceland demonstration site for earthquake predictability and RLA), due at month 42, the preparation of which will be coordinated by EUCENTRE.

2.5.4 Task 6.4: Application of a User-Centric Dynamic Risk Framework for Switzerland

Deliverable 6.6 was submitted as part of this task. This deliverable considered only the IT framework for the assessment of economic losses in a dynamic risk context.

The quantitative economical assessments, risk- cost-benefit assessment and optimization, resilience enhancements will be reported in D6.4; report on the user-centric dynamic risk framework for Switzerland application

Improving observational capabilities in Switzerland

In the context of improving observational capabilities in Switzerland, progress has been made on both the real-time relative relocation software (rtDD1) and template matching one2. The rtDD module has been further improved and a robust workflow has been established around the tool within the seismic monitoring routine at SED. The software can be considered mature and ready for third party usage. More advancements have been also made with respect to template matching for real-time applications.

[1] Double-Difference relocation module development page https://github.com/swiss-seismological-service/scrtdd (zenodo DOI10.5281/zenodo.5337361)

[2] Template Matching module development page https://github.com/damb/scdetect

The development of a real-time TM software has progressed and it is now actively tested. The plan for the next year is to continue the development of the module and in parallel to use it in selected projects for the evaluation in real world applications.

Dynamic hazard and risk communication in Switzerland

To enhance the dynamic hazard and risk communication in Switzerland, we have already conducted several research studies. Regarding EEW, we conducted an online survey in Switzerland to test EEW and REI message designs and to assess general EEW system preferences. Regarding RIA, we further developed the impact assessment outputs and collected feedback from cantonal and national authorities. Regarding event-related communication, we adjusted the earthquake messages on the Swiss multi-hazard platforms to improve the clarity and actionability of the messages based on the studies conducted in WP5. Regarding all products/services, we conducted interviews with 20 Swiss people to gain insights in their perception of EEW and OEF and with 22 European experts to learn more about future potentials and challenges in dynamic risk communication.

- Presentation on the EEW survey [manuscript is ready for submission] at the ESC Conference: Dallo & Marti (2021). Earthquake Early Warning in countries where damaging earthquakes only occur every 50 to 150 years – the Swiss case study.

The next steps are the following: Regarding RIA, we will conduct an online survey with the Swiss public to assess the correct interpretation and action-ability of the information provided and further workshops with the cantonal/national authorities to adjust the RIA outputs to their specific needs. Regarding OEF, we will run an online survey with the Swiss public to test the OEF visualisations we developed based on the insights from our conducted interviews.

Real-time earthquake risk reduction options for Switzerland

This task is linked to Task 4.6, where a CBA is applied to various RISE modules. In parallel, we are working on alternative frameworks where a direct monetizing of the benefits is not meaningful, therefore different approaches may be used. In the next 6 months, we will work on developing a framework, where we can decide on when to perform a CBA and where not. We will work on alternative ways such as using surveys and expert opinion when a CBA cannot be performed. This will lead to suggesting prioritising the resources in the most efficient way.

Within Task 6.4 we initiated a stakeholder dialog, with a focus on Swiss-specific user requirements. There will be a stakeholder meeting in Spring 2022, attached to the RISE Annual Meeting.
The next phase of the project, these actions will amount to a sound and rational risk reduction plan to manage low-probability/high-impact events in Switzerland. It will also serve as a demonstration and blueprint for other nations to consider for building their own national Dynamic Risk Information Service.

2.5.5 Task 6.5: Demonstrating RLA, EEW and OEF capabilities at a European level

30-month update:

A "good-practice report" on European Rapid Earthquake Loss Assessment has been produced as part of Task 8.4 (milestone MS61). A first version demonstrator of the European Rapid Earthquake

Loss Assessment service has been openly published on a GitLab repository (https://gitlab.seismo.ethz.ch/hcrowley/rapid_loss_eu). This demonstrator uses web services to automatically download ShakeMaps as soon as they have been published on the European ShakeMap system (from Task 4.1), retrieves the exposure models for the countries covered by the Shake-Map grid (from Task 4.1), and launches the scenario damage and risk calculations with the OpenQuake-engine (using vulnerability models from Task 4.1). This demonstrator is thus the first step towards operationalising state-of-the-art rapid earthquake loss assessment in Europe.

Combining the activities of Task 3.3, Task 4.1 and Task 5.2, the milestone MS44 (Operational versions for OEF, RLA and crowdsourcing based EEW capabilities at European level installed) has been partially reached, though additional efforts will be required in the last stage of the project to work towards making these services truly “operational” for key stakeholders. This is particularly true for the European OEF and RLA, for which there are currently demonstration versions of these services that are being used internally within the project. Instead, operational services for crowdsourcing based EEW are currently available (see Task 5.2).

Plan for M30-M42:

The services for RLA, OEF and EEW will be demonstrated in meetings with the Stakeholder Panel such that feedback on these services can be obtained and documented for future improvements, also beyond the end of the project.

Planned developments to the European Rapid Earthquake Loss Assessment demonstrator (described above) during this period, as further contributions towards making this service operational, will include the disaggregation of the exposure data to a high-resolution grid and/or the integration with high resolution data from the dynamic exposure model (Task 2.7), the inclusion of a timestamp on the versions of ShakeMaps (so that the loss assessment can be updated when updates to a given ShakeMap are made) and the automatic generation of a summary PDF file summarising the main statistics and maps obtained from the analyses. The latter will involve interaction with WP5 on the communication of loss results.

These developments will be reported in the final deliverable D6.5 (Report on the development of RLA, EEW and OEF at European scale) due at month 42.

2.6 Work Package 7 – TESTING

“Rigorous testing and validation of dynamic risk components”

Lead: GFZ
Authors: Danijel Schorlemmer, Asim Khawaja, Max Werner

General Overview & 30M Update:

Use of resources for WP7 is summarized in the table below.

Partner Name	PMs Total	PMs Claimed in the 1st RP	To be used in 2nd RP
ETH	4	7	-3
GFZ	40.00	29.85	10.15
UBRIS	4.00	10	-6

UEDIN	17.00	27	-10
UNINA	19.00	13	6
BIU	4.00	1	3
UKRI	1.00	0.61	0.39
QUAKE	3.00	0	3
Total	92.00	88.55	3.45

2.6.1 Task 7.1: Developing and implementing the CSEP2.0 framework and test-centre

30-month update: The main objective of this task has been achieved. The new CSEP 2.0 framework, now called pyCSEP, has been published (D7.1) and is already been used by many modelers of the RISE consortium. It is also, as designed, the backbone of the testing experiments conducted by RISE. These have been reshaped by the community into the concept of floating community experiments to reduce the obstacles in participating in CSEP and to increase reproducibility and transparency of CSEP experiments. The first experiment released is the global experiment in which a new multi-resolution grid technique based on the Quadtree approach, developed in RISE, is implemented (MS47). Simultaneously, the prospective evaluation of the 2010 Italy Forecasting Experiment and analysis of the best performing models' components is underway. New test metrics (MS49) have been proposed for this experiment: K-Ripley function envelope and Matrix T-W comparison tests. Likewise, the impact of catalog temporal and spatial variabilities on seismic forecasting and hazard has been tested in the context of the upcoming New Zealand hazard model. We explored the statistical power of the CSEP Spatial-test (S-test) and how it can be increased by the use of multi-resolution grids for forecasting.

Plan for M30-M42: In continuation of the global experiment, the multi-resolution grids for earthquake forecast models will be used to explore the necessary information content in a forecast to investigate what level of forecasting detail is warranted by the input data. This approach will help understanding the limits of predictability and provide insights to the limits of precision in forecasting. The last year will see the full implementation and distribution of the floating new OEF Italy testing experiment. To serve the community and foster their ideas, we will create a framework for easily deployable, floating forecasting experiments and incorporate it in pyCSEP. pyCSEP will continue to be improved by the larger RISE modeler and tester community. pyCSEP and the floating experiments will be directly connected to the Zenodo platform to allow for easy reproducibility of the experiments by the community or interested users.

2.6.2 Task 7.2: Test new physics-based, stochastic and hybrid OEF models

30-month update: Task 7.2 is on track for completion.

Testing physics-based, stochastic and hybrid models in California: Bayona, Savran, Rhoades & Werner (2022) published a prospective evaluation of 22 seismicity forecasting models in the Geophysical Journal International (https://doi.org/10.1093/gji/ggac018). Notwithstanding the promise that retrospectively optimised hybrid models had shown, their prospective test showed that the original models fared better and that - surprisingly - the adaptive smoothing of small earthquake locations continues to outperform all other models after 15 years of testing.

The CSEP reproducibility package concept: Bayona et al. (2022) also introduced the concept of the CSEP reproducibility package, which is a structured set of files containing all code, data and forecasts to replicate all the results in the associated article. The reproducibility package is transforming CSEP away from operations within firewalled testing centers towards open access floating experiments stored in online repositories. (See https://github.com/bayonato89/Reproducibility-hybrids)

Testing physics-based and stochastic OEF models in Italy: UEDIN Phd student Cheng, Main, Segou and Werner are developing physics-based seismicity forecasts for Italy. Retrospective results are showing improved predictive skills of the Coulomb stress/rate-state models when accounting for heterogeneous fault geometry and small earthquakes as additional stress sources. This supports earlier RISE-funded findings by Mancini, Segou, Werner & Parsons (2020, BSSA) on the 2019 Ridgecrest earthquake sequence. Stochastic models (Epidemic Type Aftershock Sequence models) continue to hold a slight edge over Coulomb/rate-state models.

The utility of high-resolution catalogues for physics-based and stochastic forecasting: Machine learning, template matching and other techniques are transforming earthquake catalogues in terms of quantity and quality. Mancini, Segou & Werner are assessing whether the additional wealth of information can be exploited for additional predictive skill of physics-based and stochastic forecasting models. Their work suggests that the higher resolution requires new models and testing approaches.

Testing methodology: UEDIN PhD student Serafini, Naylor, Lindgren, Werner & Main resubmitted a revised manuscript to Geophysical Journal International that develops methods for assessing the ‘properness’ of skill scores. They show that the parimutuel gambling score, which was previously used in some CSEP experiments and elsewhere, is generally improper and should thus generally not be used to compare forecasts.

Testing key hypotheses: In addition to the above studies, several works are pursuing key hypotheses of seismogenesis. Husker, Bayona, Werner & Santoyo are assessing the predictive skill of the seismic gap hypothesis. Using classic 30-year forecasts for the Mexican subduction zone published in 1987, the authors show that the seismic gap hypothesis performed worse than a simple benchmark and that the implemented model suffers from inconsistencies and significant subjectivity. Churchill, Werner, Biggs & Fagerang are assessing the role that afterslip might play in controlling aftershock productivity.

Milestones and Deliverables achieved:

MS48: Software development for tailored experiments completed

MS49: Implementation of key hypothesis tests and new metrics

D7.2: Report on first results of hypothesis testing (in preparation)

Plan for M30-42:

MS50: Complete test runs for all key hypotheses.

- Cheng et al. will complete retrospective model development and testing of new physics-based forecast models for Italy and submit the model for prospective testing in the CSEP Italy experiment.

- Mancini et al. will complete their assessment of the utility of high-resolution catalogs for forecasting using the Central Apennines (Italy) earthquake sequence as a test case.
- Bayona et al. are assessing the relative predictive skill of global versus regional forecast models, assessing the question whether regional models can exploit local datasets or are overfitting regional characteristics.
- Husker et al. will complete their test of the seismic gap hypothesis.
- Churchill et al. will complete testing the hypothesis that aseismic afterslip controls the productivity of aftershocks.

2.6.3 Task 7.3: Optimizing earthquake forecasting capabilities through ensemble modelling

30-month update:
In this time period we have carried out the work contained in the deliverable D7.3 that will be submitted in the due time. After a long and detailed review of the existing procedures for ensemble modeling in different fields, we have explored the optimal strategy for operational earthquake forecasting with a real example of the model used in Italy. In essence, the method consists of two innovative ingredients: i) the weights of the models are not assigned as a function of their single performances, but maximizing the forecasting skill of the ensemble model; ii) the ensemble model takes into account in a proper way the aleatory variability and the epistemic uncertainty allowing an ontological validation of the model. The application to the Italian OEF system shows a superior skill of the ensemble model with respect to each single model.

Plan for M30-M42:
In the last year of the project, we aim at preparing a standalone code in python of the ensemble modeling strategy to be implemented and used in the prospective CSEP experiments. We also explore different strategies to build hybrids models (e.g., aggregating stochastic and physics-based models) and understand the differences with ensemble modeling in terms of earthquake forecasting.

2.6.4 Task 7.4: Formal testing of ground motion forecasts, micro-zonation, exposure and loss models

30-month update: A new testing procedure for non-linear site amplification models was developed (D7.4) and applied to two new datasets: ESM (European Engineering Strong-Motion) and NGA-West2 (Next Generation Attenuation Relationships for Western US). For both datasets the non-linear amplification models perform better than for the Japanese strong motion KiK-net (Kiban-Kyoshin) network tested by Loviknes et al. (2021). Overall, the non-linear models do not perform well with the 30m time-averaged shear-wave velocity (VS30).
For the testing of exposure and loss models, we have collected damage reports from the Samos and Petrinja earthquakes. The micro-zonation testing was not possible because the Valais sensor deployment was abandoned due to the chip crisis, thus MS54 was not reached.

Plan for M30-M42: With the completion of the dynamic exposure model from T2.7 for the affected countries, we will investigate the match of the predicted damage by the exposure model given the best estimate of the shaking distribution in the cases for which damage data in Europe is available. In the case of another damaging earthquake in Europe, we will collect the damage data for further tests. Depending on the chip crisis and the sensor deployment within RISE, we will consider conducting further tests, however, as of now these cannot be planned.

Loviknes, K., S. R. Kotha, F. Cotton, and D. Schorlemmer (2021). Testing Nonlinear Amplification Factors of Ground-Motion Models, Bull. Seismol. Soc. Am. 111, 2121–2137, 10.1785/0120200386

2.7 Work Package 8 – IMPACT

"Exploitation, dissemination and services for securing a demonstrable societal, economic and scientific impact of RISE"

Lead: ETH
Authors: Michele Marti

General Overview & 30M Update:

Use of resources for WP8 is summarized in the table below.

Partner Name	**PMs Total**	**PMs Claimed in the 1st RP**	**To be used in 2nd RP**
ETH	30	1.49	28.51
GFZ	1	0	1
INGV	2	1.28	0.72
IMO	8	0.27	7.73
UNIBO	2	0	2
UNIVBRIS	2	0	2
UEDIN	1	0	1
UNINA	8	5	3
BIU	2	1	1
EUCENTRE	6	1	5
EMSC	4	0	4
UGA	2	0	2
UCAM	6	0	6
BOUN	2	1	1
UNIBG	2	0	2
QUAKE	4	0	4
Total	82	12.04	69.96

2.7.1 Task 8.1: Plan for the Exploitation and Dissemination of Results (PEDR)

30-month update:

The Plan for the Exploitation and Dissemination of the project's Results (PEDR) defines the metrics to measure the RISE project's impact. In order to promote RISE's activities and results, we use a number of communication tools targeted at different audiences, such as project website, external newsletter, social media (e.g. Twitter), best practice reports, special issue publications, training workshops (see chapter 2.7.4, task 8.4). Some of these communication tools are already established for the RISE project (project website, newsletters, twitter account) and others (i.e. good practice reports) will become available by the end of February 2022 or latest by the end of the project.

The external communication channels (website, newsletters, Twitter) are all maintained by WP8. In order measure the success of these formats, a set of measures and metrics were established in the first PEDR deliverable (D8.1, submitted M3 of the project). For quantitative measurements, the following metrics are considered, including goals defined for each year of the project: website users, Twitter followers, newsletter subscribers, publications, and number of participants of stakeholder exchange. Through regular management of the communication channels (i.e. 229 Tweets, 3 external newsletters, 16 news articles on the website), we were able to significantly increase the number of website visitors, Twitter followers and newsletter subscribers. Thus, we are optimistic to reach the targets set for M36. By M30 of the RISE project, RISE members have also held presentations on conferences and published over 40 research papers yet. An up-to-date list of publication is online available: http://rise-eu.org/dissemination/publications/.

For the PEDR deliverable 8.3 due at the End of February 2022 (M30), we added to the quanitative metrics, qualitative indicators to measure RISE's impact in terms of **science**, **society**, **technology** and **economy**. For this purpose, we prepared a comprehensive questionnaire with about 45 questions to assess for each work package (WP) and task within RISE their contribution to these four fields as mentioned above, therefore, all workpackage and task leaders were asked to fill in their answers. The questionnaire will be repeted by the end of the project. The evaluation and results of the questionnaire are documented in Deliverable 8.3 (M30).

Submitted deliverables by M30: 8.1 (M3) , 8.2 (M12), 8.3 (M30)

Submitted milestones by M30: MS55, MS60

Plan for M30-M42:

In order to achieve the quantitative goals, set for M36, communication activities will be continued and regular updates of news articles, tweets and interesting newsletter issues should be ensured. Special attention must be paid to increasing the number of newsletter subscribers, as this is usually a challenging undertaking. To qualitatively measure the impact of RISE in terms of science, society, technology and economy compared to M30, the PEDR questionnaire will be repeated by the end of the project. In the last project period, we have to dedicate more attention to conducting the stakeholder panels. Although we have some delays due to Covid-19, we are working on expanding the stakeholder panels by contacting more institutions. A subgroup of the Stakeholder Panel will form the National Swiss Stakeholder Board. The format of all stakeholder panels will be a workshop, where the different products and services developed within RISE will be presented and discussed. Besides technical aspects, social ac-ceptance and communications will be in the focus of the dialogue. Therefore, RISE will make use of its interdisciplinary capabilities to organize and conduct these workshops.

2.7.4 Task 8.4: RISE external communication, good practice series, and training

30-month update:

RISE website was launched in September 2019 by WP8. It is used for sharing relevant project information, dissemination materials and linking to the internal platform (Alfresco). The RISE website promotes visibility and transparency towards stakeholders. It contains a number of sections including news and events, project results, reports, publications, and access to submitted deliverables. The website is regularly updated by WP8. In 2021, the website had 663 unique visitors, a significant increase compared to 2020 with 424 visitors.

Additionally, WP8 maintains a Twitter account (@research_RISE), where we share project updates, interesting news, available open positions, etc. Currently, we have 273 followers on the RISE Twitter account and have posted more than 230 Tweets (incl. retweets) so far.

RISE external newsletters target all interested stakeholders and aims at communicating project updates and progress. So far, three external newsletters have been published and are online available: http://rise-eu.org/dissemination/newsletter/. They cover information on RISE achievements, provide insights into specific topics related to RISE, and any miscellaneous topic that RISE community wants to share with the public. The external newsletter are published once a year during RISE project. Currently, 220 subscribers have registered for the newsletter. With a relatively high opening rate of 56% on average, the newsletters have met with great interest.

RISE has to compile a series of at least five good practice reports. Each good practice report will undergo an internal peer review. The reports will be written with an end-user perspective in mind. The following three reports are currently under development by several RISE project members and will be submitted by the end of February 2022 (MS61). All of them will be made available on the RISE website.

- How can we fight earthquake misinformation? The Communication Guide
- New developments in physics and statistics based earthquake forecasting
- European rapid loss assessment

D8.10 External Newsletter released (month 6), D8.11 External Newsletter released (month 18)

MS59: RISE web page fully operational, MS61: 3rd best practise report online

Plan for M30-M42:

As in the previous months, the RISE website and Twitter account will be regularly updated and new articles published. On the website, the good practice reports will be made available online. In addition, at least one external newsletter will be published during the last project period. Furthermore, two additional good practise reports have to be compiled, so that we reach the goal of at least five good practise reports.

D8.12 External Newsletter released (month 36)

MS63: Final conference conducted

MS62: First Training workshop conducted