



1. INFORMATION ON THE ACTION	
Grant Agreement Nº	INEA/CEF/ICT/A2018/1837945
Action Title (Art. 1 of G.A.)	Urban Co-creation Data Lab (UCD Lab)
Action number (Art. 1 of the G.A.)	2018-EU-IA-0099

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2. IMPLEMENTATION OF THE ACTION¹

2.1. Overall completion of the Action

Planned Start/End date ²		Actual Start/End date		Completion ³
01/10/2019	28/02/2022	01/10/2019	24/05/2022	89%

2.2. Completion per activity/work package

Activity 1	Title ⁴	Planned Start/End date ³		Actual Start/End date		Completion
	Data Preparation and open data infrastructure assessment	01/10/2019	31/12/2020	01/10/2019	31/12/2021	100%
Milestone no	Title ³	Planned date ³		Actual date		Reached (Y/N)
2	Data sets requirements defined for all 3 cities	31/12/2020		31/12/2021		Y
4	Service and Use Cases full definition for all 3 cities is ready	31/12/2020		31/12/2021		Y

Activity 2	Title ³	Planned Start/End date ³		Actual Start/End date		Completion
	Services refinement and preparation analytics and HPC	01/04/2020	31/12/2021	01/04/2020	31/12/2021	83%
Milestone no	Title ³	Planned date ³		Actual date		Reached (Y/N)
6	Data models including refined analytical models (descriptive, predictive, and prescriptive models) that support the city's planning and management and 5 analytical services are deployed in HPC	30/09/2021		31/12/2021		Y
7	HPC resources have been used to process the data as required by the Action	31/12/2021		28/02/2022		Y
8	Compliance with the Metadata Quality Assurance (MQA) tool for datasets	31/10/2021		24/05/2022		N

¹ For Interim report: please describe the completion of the action until the end of the reporting period as specified in the Grant Agreement.

² As specified in Art. 2.2 of the Grant Agreement.

³ The completion of the Action and of each activity/work package should be indicated as a percentage.

⁴ As specified in the Grant Agreement.

Activity 3	Title ³	Planned Start/End date ³		Actual Start/End date		Completion
	Co-Creation Labs: perform experiences and validation by cities	01/10/2019	30/11/2021	01/01/2021	28/02/2022	100%
Milestone no	Title ³	Planned date ³		Actual date		Reached (Y/N)
5	Defined methodologies to be followed in all cities' co-creation labs are ready	30/09/2021		30/09/2021		Y
10	Complete use cases implementation in all cities' Co-Creation Labs	30/11/2021		30/11/2021		Y

Activity 4	Title ³	Planned Start/End date ³		Actual Start/End date		Completion
	Dissemination and communication of results	01/10/2019	28/02/2022	01/10/2019	28/02/2022	100%
Milestone no	Title ³	Planned date ³		Actual date		Reached (Y/N)
3	Elaboration of dissemination strategy and setting up of dissemination channels	30/04/2020		30/04/2020		Y
11	Final reach assessment	31/12/2021		28/02/2022		Y
12	Final conference in Lisbon	28/01/2022		11/02/2022		Y

Activity 5	Title ³	Planned Start/End date ³		Actual Start/End date		Completion
	Future sustainability	01/10/2019	31/12/2021	01/10/2021	28/02/2022	100%
Milestone no	Title ³	Planned date ³		Actual date		Reached (Y/N)
9	For all services: identification of viable business models and willingness to buy verified	31/12/2021		31/12/2021		Y

Activity 6	Title ³	Planned Start/End date ³		Actual Start/End date		Completion
	Project Management	01/10/2019	28/02/2022	01/10/2019	24/05/2022	50%
Milestone no	Title ³	Planned date ³		Actual date		Reached (Y/N)
1	Project management plan including quality assurance and risk management	31/10/2019		31/10/2019		Y
13	Beneficiaries to deliver a demonstration of their Action's results via a remote or onsite meeting with DG CNECT	31/01/2022		24/05/2022		N

2.3. Description of the implementation of the Action, including the actual status at the end of the Action (or of the reporting period) and possible deviations from the planned activities, and, if applicable, compliance with any relevant specific provisions as indicated in the Annex I of the GA

The main goal of the action "Urban Co-Creation Data Lab" was to support decision-making at municipality level to provide citizens with high quality services in the areas of security, emergency, operational management, and planning. This support should be deployed in Lisbon plus two European cities. This support in decision making to the cities, was guaranteed through the development of five analytical services in the below thematic areas:

- Mobility: by supporting new planning and management approaches altogether with new tools to evaluate impact and prediction of behaviours
- Waste management: by identifying patterns to support the prediction of the production of urban waste associated with a variety of context information
- Parking: by creating new models either to predict or to generate viable alternatives for illegal parking in the city
- Pollution: by developing predictive models for the propagation of liquid and atmospheric pollutants
- Emergency: by developing predictive models for the prediction and identification of the risk of urban traffic accidents

The data lab developed for Lisbon pretended to use its analytical capabilities together with the best expertise at European level to make openly available the results of the action. Besides this, the action aimed to develop a new generation of public services in the context of smart cities exploiting supercomputing facilities and public and private data, to analyse complex combinations of large datasets in areas of public interest.

To achieve the above objectives were developed the following activities:

- Activity 1 – Data preparation and open data infrastructure assessment
- Activity 2 – Services analytics refinement and HPC preparation
- Activity 3 – Co-Creation Labs: perform experiences and validation by cities
- Activity 4 – Dissemination and communication of results
- Activity 5 – Future sustainability
- Activity 6 – Project management

The completion level of each activity was computed considering the mean value of milestone completion for each activity, in which was considered:

- 0% - the verification mean of the milestone did not start
- 50% - the verification means of the milestone started
- 100% - the verification mean of the milestone is completed

The completion level of each activity was computed using equation 1:

$$Completion\ of\ Activity\ x\ (Ax)\ (\%) = \frac{(MS1 + MS2 + MSn)}{n} \quad (1)$$

In Table 1 is presented the completion level of each milestone

Table 1. Level of completion of the Action milestones until the submission of the technical report.

Activity	Milestone (MS)	Completion
A1	Data sets and requirements defined for cities (MS2)	100%
	Service and use cases full definition for cities is ready (MS4)	100%
A2	Analytical models will be disclosed in public via Lisboa Aberta (MS6)	100%
	Report on supercomputing resources used (MS7)	100%
	Compliance with the Metadata Quality Assessment (MQA) (MS8)	50%
A3	Report on Co-creation labs methodology (MS5)	100%
	Report on completed use cases implementation (MS10)	100%
A4	Elaboration of dissemination strategy and setting up of dissemination channels (MS3)	100%
	Reach assessment report (MS11)	100%
	Final conference (MS12)	100%
A5	Report sustainability and willingness to buy (MS9)	100%
A6	Beneficiaries to deliver a demonstration of the Action's results (remote or onsite) (MS13)	0%
	Project management plan including quality assurance and risk management (MS1)	100%

The completion level of the Action was computed considering the mean value of completion of all activities (equation 2):

$$\text{Completion of Action (\%)} = \frac{(A1 + A2 + A3 + A4 + A5 + A6)}{6} \quad (2)$$

Activity 1 – Data preparation and open data infrastructure assessment

This activity had as objective to prepare data and open data infrastructure for cities Smart Management Platform. This was achieved through: 1) the identification of datasets required for the three cities; and 2) the definition of services and use cases for the three cities. For the definition of the use cases, for each analytical model several meetings were conducted with departments of Lisbon City Council to delineate the objective of each analytical service and if it provided value to the city council. The definition of use cases and the analytical services are described in the report [Service and use cases full definition for cities is ready](#) for the fulfilment of MS4. The definition of the use cases was developed in parallel with the identification of the datasets available as they will condition the use cases and the analytical services that can be developed. Also, in this activity was configured an Azure data lake to store the data that was used for the development of the analytical models for each use case. The datasets defined for each use case are presented in the report [Data sets and requirements defined for cities](#) for the fulfilment of MS2.

The actions developed in this activity were just accomplished for Lisbon City Council and the Provincial Council of Badajoz. Indeed, and despite the several contacts conducted to engage other European cities, just the Provincial Council of Badajoz accepted the invitation to participate in the project and just for the development of the use case #2 – Waste management. To notice that due to the COVID-19 pandemic, cities had to focus their resources to handle the challenges in city management considering the pandemic and the respective lockdown that led to mandatory remote work of city technicians.

The deviations from the planned date were due to the effort related with the developments and refinement of the analytical models that were developed in Activity 2. Indeed, the several training and test of the different models required to adopt and test different approaches and using different datasets, from which were obtained different results and consequently different responses to the use cases. For this reason, Activity 1 have the same actual date of Activity 2.

This extension required the use of more human resources (HR), namely from NOVA IMS, NECPT, and CML. However this increase in HR did not affect the execution of Activity 1 that had an execution of 89%. The cost saving in HR of 44% by BSC was because of the researcher involved in Activity 1 was hired one month after the project started.

Activity 2 – Services analytics refinement and HPC preparation

The main objective of this activity was to deploy the identified services in the co-creation labs and connect them with HPC infrastructure and with, the applications and the city services to be provided to users and stakeholders.

The activity started with the development of the analytical services for each use case. Several types of models were developed in this activity and specific for each use case, namely: 1) time-series models for the micromobility and waste management; 2) a Wall-Modelled Large Eddy Simulation (WMLES) for pollution; 3) and decision trees and neural networks for parking and emergency. The analytical models and the services specifications were disclosed and made available in Lisbon Open Data Portal, in a web page dedicated for the project [UCD Lab](#).

Regarding the use of HPC resources and the deployment of the analytical models, HPC have been used to develop the pollution use case. The micromobility model was deployed in the Lisbon Intelligence Management Platform (PGIL). The use of HPC resources and the deployment of the analytical models is presented in the [Report of the supercomputing resources](#) for fulfilment of MS7. MS7 was delayed two months to test the model of micromobility in production in PGIL, to have metrics of usage of the model. The remaining model's implementation is presently being evaluated by CML to deploy them in PGIL following the feedback for the internal users as the prior development of the analytical models was delayed due to difficulties:

- Data access
- Time needed to train the different analytical models
- Dealing with unbalancing data, namely in the development of the analytical models for parking and emergency
- In reaching the necessary compromise between technical quality and the fulfilment of the requirements of the several Lisbon City Council departments regarding the analytical services

Regarding the metadata quality assessment (MQA) of the datasets generated by the project at the moment of the submission of the final report, the metadata files for each dataset are being generated using a tool developed by the consortium during the action – [Metadata JSON Generator](#) that generates metadata in json-ld format. However, the Lisbon Open Data Portal does not allow to create or upload metadata files in json-ld or rdf format and for that reason the metadata created could not be harvested by the Portuguese Open Data Catalogue and consequently by the European Data Portal. For this reason, the MS8 – Compliance with the Metadata Quality Assessment (MQA) is not completed, resulting in the level of completion of Activity 2 of 83%. In the beginning of July the generated datasets will be published in Lisboa Aberta, harvested

in the Portuguese Open Data Portal, and harvested by the European Data Portal. The linked metadata generated by the European Data Portal will allow the verification and completion of MS8.

To create synergies between the consortium team that developed the analytical models and the academic community, [a call for papers and a workshop](#) have been disclosed to promote the creation of knowledge regarding the five challenges of the Action. The workshop was initially defined to take place between the 18th and 20th May 2021 in Lisbon. The call for papers has been done in collaboration with the Sustainability Journal that opened a special issue entitled "[Urban Analytics and Creation of Services for Sustainable Cities](#)". About 1264 researchers have been directly invited to participate in the workshop, along with the disclosure of the event in the communication channels of the Action. Despite this effort there was just one submission of works for the workshop. Indeed because of the COVID-19 pandemic there were no applications for the workshop and the activities planned were postponed for the workshop and activities developed during the Lisbon Conference.

The absence of commitment of additional cities in the action, for the improvement of the developed analytical models during the action it took the consortium to develop several actions to cope with this fact namely through:

- Brainstorming sessions for each analytical model in the [Portugal Smart Cities Summit 2020](#) with live feed in the Facebook channel of [NOVA Cidade – Urban Analytics Lab](#)
- Challenges and data provider in the [World Data League 2021](#) in the scope of the action, namely in the [Identification of patterns and prediction of irregular parking](#) and [Patterns and predictive modelling of traffic accidents](#). Members of the consortium participated also as mentors and jurors in the hackathon.
- Interviews and online survey - to integrate insights from both the external (students and citizens) and internal (partners and lab members) community and create a platform for behavioural research and idea-creation of new projects and services within the five challenges of the Action ([Strategy and Insights Engine Project](#))
- Urban safari and design thinking session made in the final [Lisbon conference](#)

Activity 2 had an execution of 79% of the initial estimated cost. This aspect was mainly because there were no other costs than HR for all the partners excepting for NOVA IMS. Despite this aspect, the HR costs increased for NOVA IMS (21%) because of the definition of data models took more time than what was expected. This was due to adjustments that had to be made in the analytical models to: 1) have the initial defined quality levels; and 2) to fulfil the analytical services requirements of the different Lisbon City Council departments. Also the development of an [online application to generate metadata in json-ld format](#) had an impact in the increase of HR by NOVA IMS.

Activity 3 - Co-Creation Labs: perform experiences and validation by cities

The objective of this activity is to validate the Co-Creation Labs proposed services in selected cities (Lisboa + 2) and adding new use cases.

To test the methodology applied to Lisbon and engage other cities in project, several cities/regions have been contacted to participate in the project following previous contacts and networks of CML and similarities in the approach in cities intelligence platforms development (Córdoba, Region of Badajoz, Rotterdam). As mentioned previously the COVID-19 pandemic made cities focus their resources in managing the pandemic and for that reason the engagement of other cities was very difficult. In the context of the action only the Provincial Council of Badajoz accepted the invitation to test the analytical models developed in Lisbon using data for the provincial council. The Provincial Council of Badajoz demonstrated interest in the development of the waste management use case like implemented for Lisbon. Despite just the Provincial Council of Badajoz accepted the invitation, this led to a new perspective in the action as the Provincial Council of Badajoz is responsible to manage waste not in the city of Badajoz, but to the entire region of Badajoz. This aspect was challenging as in the context of the action, the consortium tested a model to predict waste production at city level to region level, increasing the potential of models' reutilization not just to cities, but also to regions.

To cope with the lack of engagement of other cities in the project, the consortium participated in the [World Data League 2021](#) as challenge provider of two challenges addressed in the Action, namely for [parking](#) and [emergency](#), where the participants used data from the cities of Vancouver and Waterloo, respectively.

Due to the COVID-19 pandemic, the workshops that were planned for the action with researchers and city technicians were not possible to be made due to the impossibility of movement. For this reason all these activities were concentrated in the [Lisbon Conference](#) event that marked the end of the action that was held between 9 and 11 February 2022. However, and despite this inclusion of the workshops in the final conference, this aspect made us look for alternative ways to reach researchers and city stakeholders. The handbook and the Urban Empathy Toolkit insights were not considered in preliminary phases of the project but can be considered in future similar initiatives. This aspect is important as the definition of the use cases and the development of the analytical services did not consider the feedback from city stakeholders and researchers and the knowledge that could leverage the Action results by their insights. However, both outputs can be used in future projects considering the creation of analytical services for other cities taking advantage of their open data and the publicly available analytical models disclosed in the context of the Action. The final conference held in Lisbon, counted with the presence of more than 40 participants with several backgrounds from municipalities technicians and managers, researchers from universities and technicians and researchers from private and public companies. Several activities were developed during the three days to overcome the limitations of the workshops not taking place:

- 9 February: explore by insights and visit through the streets of Lisbon in an urban safari, with the aim of capturing, through interviews and photographs, the details of the city within the scope of the five related topics of the action

- 10 February: presentation of the individual experiences of the research safari of the previous day
- 11 February: brainstorm and debate to assess the essential interventions for a better management of the municipality, and what opportunities are there to innovate and implement data centred efficiency improvements.

The conclusions of the several activities developed during the Lisbon Conference are available in the [report of the Lisbon Conference](#).

From this activity resulted the following outputs:

- [Legal and regulatory framework on open data collection for each city](#)
- [Report on Co-Creation Labs methodology, framework, and technological tools](#)
- [Report on completed use cases implementation in all cities](#)
- [Handbook for smart cities Co-Creation Labs](#)

The overall cost of Activity 3 exceeded the budget in 11% regarding the initial estimation, with over costs by NOVA IMS and CML (11% and 6% respectively) due to additional HR needed for the development of the activities implemented in the workshop of the Lisbon Conference (an over cost in HR of 21% and 37% for NOVA IMS and CML respectively).

Activity 4 - Dissemination and communication of results

The main objective of Activity 4 is to maximize dissemination of the action results to a wide audience of researchers, city authorities, business organizations, EC, and citizens. The dissemination should be performed before and during exploration of the action results to promote collaboration with other EC related projects in Smart Cities and HPC.

The activity started with the elaboration of dissemination strategy and setting up of dissemination channels, providing the guidelines to be developed by the consortium to reach the below communication goals:

- Defining the communication objectives, roles, and procedures
- Synchronizing communication activities within the Action beneficiaries and other partners
- Supporting the best information flow between the Action beneficiaries
- Clustering with relevant EU and international programs and initiatives to enhance the impact and the broadcast of the Action

To reach these goals a communication strategy was defined with the following steps:

- Presentation of Action initial ideas, website, social media profiles, visual identity, and proposal of next steps
- Definition of templates and first procedures. Revision of website and materials
- Provision of the Dissemination and communication strategy
- Update of the Dissemination and Communication Strategy plan of activities

This strategy is available in the report of the [Dissemination and Communication Strategy](#) for the fulfilment of MS3 - Elaboration of dissemination strategy and setting up of dissemination channels.

Several dissemination activities were developed during the action to reach the objectives of Activity 4, namely:

- Interviews to magazines: to promote the action were also made interviews in magazines: [Smart Cities magazine](#)
- Newsletters: The action was mentioned in newsletters: [NOVA Cidade newsletter nº 6 \(October 2021\)](#), [NOVA Cidade newsletter nº 10 \(February 2022\)](#).
- Website: announcements related with action activities promoted in the [website](#)
- Posts in social media channels: the action was also disseminated in the website of the action, through Facebook and LinkedIn posts [NOVA Cidade Facebook page](#), [NOVA Cidade LinkedIn page](#). More detail is provided in the [Reach assessment report](#).
- Videos: Videos posted in YouTube channels: [Urban Co-Creation Data Lab Channel 1](#); [Urban Co-Creation Data Lab Channel 2](#).
- Smart cities fairs: presence in two Portuguese smart cities fairs: the Portugal Smart Cities Summit 2020 and in the Portugal Smart Cities Summit 2021. In the Portugal Smart Cities Summit 2020 that was held in the Lisbon Congress Centre between the 22nd and 24th of September 2020, the project was present with a stand where several information (flyers) and videos were presented to people that attended to the fair. Also brainstorming sessions about each analytical model were conducted with live transmission in the NOVA Cidade – Urban Analytics Lab Facebook page. For the case of Portugal Smart Cities Summit 2021 that was held in the Lisbon International Fair between the 16th and 18th of November 2021, the analytical models of each use case were presented in an afternoon session in the stand of Lisbon City Council.
- Hackathons: the action was disseminated in the [World Data League 2021](#) hackathon that was held between April and July 2021 online, providing support to the organization in developing two use cases similar to the ones that were

developed in the framework of the action, namely the prediction of illegal parking and traffic accidents. Also, members of the consortium provided support as jurists and mentors of the hackathon, and lecturing workshops to the participants.

- **Presentations in scientific conferences:** The project was present in the [VI Conference on Regional and Urban Planning/ I Conference on Data Science for the Social Sciences/ Conference of the Research Project DRIVIT-UP](#), that was held in Aveiro between the 25th and 26th November 2021. Was presented the analytical model for the use case of emergency, under the title "Prediction and simulation of the risk of traffic accidents using neural networks and gradient boosting with a hybrid classification/regression modelling approach in urban context." The abstract of the work developed was published in the proceedings of the conference (<https://ria.ua.pt/handle/10773/32855>)
- **Publication of scientific papers:** The project was also disseminated through the publication of scientific papers. A work regarding the waste management model titled the "[Impact of COVID-19 lockdown measures on waste production behaviour in Lisbon](#)" was published in Waste Management journal. Also a paper regarding the use case for parking was submitted to the journal Case Studies on Transport Policy and is under review. The work presented in the VI Conference on Regional and Urban Planning/ I Conference on Data Science for the Social Sciences/ Conference of the Research Project DRIVIT-UP regarding the emergency use case is being extended to be published in a scientific journal.
- **Lisbon Conference:** a final conference was organized and held at NOVA Information Management School between the 9th and 11th February 2021. The final conference consisted of a 3-day workshop where the first day consisted of an urban safari through the streets of Lisbon, with the aim of capturing, through interviews and photographs, the details of the city within the scope of the five related topics of the project. On the second day the results of the action were presented, and the individual experiences of the urban safari shared between the participants. On the 3rd and last day of the workshop a design thinking session was conducted to brainstorm new ideas and solutions in the scope of the five challenges of the action. The audience of the workshop consisted of researchers, technicians, and decision-makers of municipalities. Attended the 3-day workshop respectively 26, 60 and 28 persons. For fulfilment of [MS12 – Final Conference in Lisbon](#), the report is made available [here](#).

The above dissemination are also disclosed in the [web page of the Action - Newsroom](#) and [web page of the Action – Events](#).

The tools developed during the project were disclosed in the Action website, and also in the Lisbon Open Data Portal (<https://lisboaaberta.cm-lisboa.pt/index.php/pt/apps-e-analitica/ucd-lab>). To leverage dissemination and findability of the tools, they will also be disclosed in the Portuguese Open Data Portal in the Reuse section (<https://dados.gov.pt/pt/reuses/>).

For fulfilment of [MS11 - Final reach assessment](#) a report was also made available [here](#). MS11 was delayed 2 months to allow the reach assessment of the Action considering all the period of the Action. A dashboard to monitor reach assessment was made available [here](#).

For Activity 4 there was an execution rate of 90%.

Activity 5 – Future sustainability

The objective of this activity is to ensure that the action results are exploited beyond its duration and will be sustainable in the long term.

For the fulfilment of this objective was considered an approach with 4 steps:

1. Analysis of success cases and their business models
2. Desk research (e.g., existing open data uses, funding sources, needs/problems to be solved, available market studies)
3. Interviews with experts in application areas and open data
4. Analysis of project application areas (e.g., needs, sustainability potential and SWOT analysis)

An analysis of potential market and business models was performed, considering exploitation of individual components and exploitation of the integrated outcomes of the action that can be used by the consortium, a group of beneficiaries or by individual beneficiaries. According to that, the consortium designed and continuously refined a sustainability strategy aiming at ensuring long-term impact of project results at EU level. Multiple cities, private and public decision makers, small and medium-sized enterprises (SMEs) and individual citizens were interviewed to assess their interest and willingness to buy analytical services. In parallel, the analysis also focused on business models for each service, and the target markets (dimension, key decision makers, alternative solutions, etc.). From the SWOT analysis the study captures the fact that the results enable a positive background for the exploitation of the platform. Specific strengths of the Urban Co-Creation Data Lab solution include a strong players involvement in all activities, access to many users and continuous involvement of other stakeholders to better address the needs of the market. The weaknesses and threats identified include an intense competition in Europe and abroad as well as a lack of interoperability among the existing components.

For the fulfilment of MS9 – For all services identification of viable business models and willingness to buy verified, a report is made available [here](#).

Activity 5 was extended two months until the end of the project (28/02/2022) as in the Lisbon Conference a specific presentation on this topic (Sustainability study) was made on the 2nd day (10th February) to close the session (please see [Lisbon Conference program](#))

Activity 5 had an over cost of 32%. This over cost was due to BSC (with an over cost of 28%) tasks, namely in the interaction with the Civil Protection Lisbon City Council, where based on their feedback was necessary to change the scientific visualisations regarding the pollution use case to be more friendly with end user. The visualizations regarding different pollutant concentrations are available in Lisbon Open Data Portal [here](#) and the pollutants dispersion clouds available in the [YouTube channel](#) of the Action. The over costs of NOVA IMS (187%) were due to the necessity of resorting to an external entity to develop the report on the sustainability of the Action (MS9). Indeed, none of the partners had the necessary expertise to develop a report with that content, despite the follow-up of the activity. Besides this aspect the consortium believes that the Action sustainability assessment done by an external entity can bring an added value because of their intrinsic impartiality.

Activity 6 – Project management

The main objective of this activity is to ensure the quality levels of the action's results through the continuous monitoring of the action activities and their proper execution, the coordination of the work plan, and the optimum coordination of the beneficiaries.

To address the objectives of this activity, an [Action Management Plan](#) was elaborated for the fulfilment of MS1 – Project Management Plan including quality assurance and risk management. Several Action coordination meetings have been made to assure the follow up of the project (Kick-off (M1), M6, M12, M18, M21, M27). Because of COVID-19 pandemic, only the Kick-off meeting (M1) and the Action Coordination meeting on M6 were presential in Lisbon, being the remaining held remotely. To ensure the completion of Activity 2 and Activity 3 namely, to finish the training and testing of the analytical models and for the deployment of the model in PGIL, along with the testing of the waste management model with data from the Provincial Council of Badajoz, biweekly meetings have been done from June 30 (2021) to December 22 (2021). On the 20 January 2022, an additional consortium meeting was made to prepare the Lisbon Conference and the workshop that was held in Lisbon between the 9th and 11th February 2022. In Activity 6 was also developed all the work to produce all the outputs of the project along with the maintenance of the Action website.

The completion rate of Activity 6 is 50% as MS13 - Beneficiaries to deliver a demonstration of the Action's results (remote or onsite) will be only completed on the 07/06/2022 (14:00 – 17:00 Brussels time), where the demonstration of the results of the Action will be presented to the Commission.

Activity 6 had an under cost of 2%. The over cost of BSC (79%) is related with higher rate salary of the BSC staff, when compared with the initial estimated cost. NOVA IMS had an under cost of 29% due to cost savings in the logistic associated to organize on site consortium meetings as from the 6 planned meetings just the first two were presential.

2.4. Conclusions on results of the Action, including the impact of the possible deviation on 1) the objectives of the action, 2) the completion of the planned activities and 3) the cost-breakdown

Based on open data and a co-creation process it was possible to take Lisboa Urban Intelligence Platform from an operational real time descriptive analytics to predictive analytics. This aspect provided the Lisbon City Council with a new set of services and models that can be used for a better planning and management of the city, allowing not just a reaction but also an anticipation of a particular behaviour in the city (e.g., number of bikes docked, risk of illegal parking or traffic accidents). The models developed taking advantage of the technological capabilities of Lisboa Urban Intelligence Platform can be fully integrated using open data and real-time feeds, providing an additional layer of predictive analytics to the platform.

The results provided by the Action demonstrated the full potential of the creation of analytical services and their respective impact in the development of analytical solutions for the optimization and improvement of cities management and operational activities. The city verticals addressed in the Action (i.e., micromobility, waste management, parking, pollution, and emergency) served as good examples of the potential of creating analytical services resorting to data that is stored in cities transactional systems along with data available in open data portals. There was an ambition of the Action to implement the analytical services in Lisbon plus two European Cities.

The Action started with the development and data requirements needed for the development of the analytical services. For that the consortium had to have several meetings with different city council departments for the definition of the analytical services and assess the data available for that purpose. Indeed, this activity was extended to the end of the action as the results the consortium was achieving regarding each analytical model, had to be refined to fulfil the needs of the city council. This activity demonstrated to be essential for the accomplishment of the general objective of the Action.

Only the micromobility model was deployed in Lisbon. Indeed the tasks developed for the fulfilment of MS6 - Data models including refined analytical models (descriptive, predictive and prescriptive models) that support the city's planning and management and 5 analytical services are deployed in HPC, where overdue to the difficulties found in the development of the analytical models, namely to reach good levels of quality and at the same time adding value to the Lisbon City Council, with the available data. In fact, a major part of the available data used as explanatory did not have a temporal component, contributing also to more difficulties in the development of the analytical models. These constrains delayed the completion of the analytical models, and consequently the deployment of all models in PGIL - Lisbon Intelligent Management Platform was not possible, which constituted a drawback in the objectives initially defined for the Action.

Regarding MS8 - Compliance with the Metadata Quality Assessment (MQA) several difficulties have been identified and for that reason MS8 is not fully completed at the time of the submission of the final report. These difficulties were technical and included:

- Lisbon Open Data Portal that is harvested by the National Open Data Catalogue (dados.gov) is not prepared to generate metadata files in a format readable by the Metadata Quality Assessment tool of the European Open Data Portal. Presently the municipality is in a process of upgrade the open data portal which will overcome this problem;
- At the time of the project there was not from our knowledge any application to generate metadata files in accordance with DCAT specification. A web application had to be developed for that purpose;
- The consortium is assessing the possibility to publish the metadata of the generated files of the project in dados.gov to be harvested by the European Open Data Portal.

Despite these difficulties, several entities showed interest the development of the web application (e.g., Lisbon City Council, the Portuguese Ministry of Défense) that pretend to make available their open data accordingly with DCAT specifications. Despite the extra resources needed to develop the web application and the difficulties that the consortium found in their development, this web application has the potential to be a starting point for many producers of open data deliver their metadata accordingly with the technical requirements of the European Data Portal.

It was also ambition of the Action to test the models developed for Lisbon in plus two European Cities. However due to COVID-19 pandemic, the cities contacted to collaborate in the project did not accept the invitation. Only the Provincial Council of Badajoz showed interest in testing the waste management model developed for Lisbon. To notice that the Provincial Council of Badajoz is responsible for waste management of a region (with rural characteristics) and not a city. This aspect contributed to a different approach and different conclusions regarding the application of an analytical model developed for a city to a region. The results showed that the model applied for Lisbon can be applied also to a region, but there is the need to understand the underlying factors that contribute to waste production in the region. These results open a distinct perspective regarding the replicability of analytical models applied in a city to a region context, that we think have potential to be explored in future projects.

Recently (after the end of the action) NOVA Cidade – Urban Analytics Lab was visited by a mission of Chief Executive Directors of 19 European Cities to whom the action was presented, and the created analytical models demonstrated, with a very positive feedback and expressions of interest in future collaboration to apply what was developed in their cities, namely Madrid, Prague, Athens, and Budapest.

Several activities were developed for the dissemination and communication of results, namely interviews to magazines, newsletters, posts and videos in social media channels, presence in smart cities fairs; partner in hackathons providing challenges, data, mentors, and jury support; presentations in scientific conferences, publication of scientific papers and

organization of Lisbon Conference. To notice that the presence in smart cities fairs did not have the expected reach because of the COVID-19 pandemic, conditioning the access to the smart cities' fairs, especially in Portugal Smart Cities Summit 2020.

Regarding the sustainability of the Action several challenges were identified, namely:

- The variety of datasets and its potential uses can be puzzling for non-technical users (current and prospective alike)
- Lack of data standards, with some exceptions such as contracting data and transport - Open Contracting Data Standard (OCDS) and General Transit Feed Specification (GTFS)
- Reduced or difficult replication of services across MS due to asymmetry in data collection, data quality and its organization (e.g., national Open Data (OD) may be missing in European Union (EU) wide catalogues, and/or available only in national language, access only via CSV lacking use of Application Programming Interfaces (APIs), infrequent data updates, missing real time data, lack of disaggregation of data e.g., by population)
- The importance of communication - if citizens do not know about OD it will remain unused and it will be difficult to convince policymakers about its added value
- Cities struggle to find ways to provide OD to citizens or companies due to lack of resources, expertise, IT infrastructure etc.

Opportunities to guarantee sustainability of similar actions were also identified:

- Wide and rich variety of datasets available across Europe, e.g., Public Administration, Geographic, Statistics, Mobility and Climate
- Wide need for traffic and mobility services, particularly in larger cities, demand driven by commuters and mobility Apps are extremely popular and used constantly e.g., bike / scooter sharing
- Other good application areas are any environmental and real estate
- Tools and advanced training are huge necessities
- Incubation and Acceleration works well to create sustainable results, in particular corporate Accelerators, when needs and private data from corporates are also considered to create new services
- Assessment of societal impacts of event e.g., Covid and related health impacts

Several questions arise regarding the sustainability of the Action, and the maintenance of the deployed models, which should consider the HR needed to maintain the models and monitor the quality of the outputs and how this maintenance can be funded.

To cope with these challenges is necessary that Lisbon City Council resorts to analytics advanced training to their human resources as well resorting to funding opportunities that can be used for one side to maintain the implemented models and find opportunities to develop new models that can bring solutions for the optimization of services used or provided to citizens by the city council. It is worth mentioning that the training of human resources in analytics is already taking place at the Lisbon City Council.

Several funding sources can be explored:

- Funding, that can be provided by European or national funds e.g., Horizon Europe, PT 2030, Digital program
- Particularly for larger demonstration, proofs of concept or "first of its kind implementations (higher TRLs)
- Further Research and development projects (lower TRLs)
- Focus on EU initiatives on urban data or analytics (or wider scope)
- Investment funds and venture capital, for matured businesses
- Private investors, business angels, or crowdsourcing, for earlier stage businesses
- Public Private Partnerships e.g., on data or AI

The Lisbon Conference in the second day, in which were presented the insights of the research developed during the Action, contributed also for the identification of new use cases to be developed. For example, the Urban Hygiene Department of the Lisbon City Council showed interest in the development of a service to predict waste production in the five areas of macro territorial management of the Lisbon City Council one year ahead. The idea for this service is to provide to the Urban Hygiene Department an estimated waste production for each of these areas so they can plan a year ahead the necessary human resources and trucks needed to acquire to guarantee the waste collection operations. Regarding emergency the firefighters showed interest in the development of a solution based in the one developed in the project that simulates the risk of traffic accidents considering roads characteristics and updating it considering environmental variables, to provide information for a better allocation of emergency vehicles.

The design thinking session developed on the last day of the Lisbon Conference, allowed the development of five ideas for each one of the challenges of the Action, with the feedback from an audience constituted by researchers, city managers, city technicians and city representatives. City representatives showed interest in prototyping some of ideas developed during the session, which can be a good indicative of the future sustainability of the project. More details about the ideas developed during the design thinking session can be found in the [Lisbon Conference report](#). The adopted approach was extremely useful and could be a good practice for future initiatives being the methodology available in the Lisbon Conference Report.

A good example of the positive feedback of the participants in the design thinking session was the contact with the consortium by the Civil Protection Department of Lisbon City Council, who showed interest in the development of a decision support system. This decision support system can be based on machine learning models that uses open data and transactional data available in the Lisbon City Council, to simulate the impacts of environmental and hazards risks, identified in the Lisbon

Municipality Emergency Plan (e.g., floods, tsunamis, earthquakes, accidents with hazard materials, collapse of tunnel and bridges, fire in urban areas), to people, critical infrastructures, and crowded locations (due to cultural/sports events).

To notice that the implementation of a system with these characteristics is only possible with the recent effort done by the Lisbon City Council in providing high value open data sets (e.g., was installed in 2021 an environmental and air quality network with 80 sensors) and data that monitors the quantity of people in periods of 5 minutes in a grid of 200 x 200 m resorting to mobile phone data provided by a private telco. Also, this investment in making available more rich datasets can be explored in the future to create better solutions for city operations and citizens, being a fundamental aspect for the sustainability on the medium long term of the Action.

3. VISIBILITY OF UNION FUNDING

What measures have been taken to publicize the Action, including EU funding (GA II.7.1)?

Several measures have been taken to publicize the Action such as presence and presentations in scientific conferences, presence in smart cities fairs, publication of scientific papers, participation in hackathons, production of materials (roll ups, notebooks, flyers), interviews to magazines and reference to the action in newsletters, posts in social media channels (Facebook and LinkedIn) and videos on YouTube channels.

- Presentations in scientific conferences: the action was promoted through the presence in the [VI Conference on Regional and Urban Planning/ I Conference on Data Science for the Social Sciences/ Conference of the Research Project DRIVIT-UP](#), that was held in Aveiro between the 25th and 26th November 2021. In this conference, was presented the analytical model for the use case of emergency, under the title "Prediction and simulation of the risk of traffic accidents using neural networks and gradient boosting with a hybrid classification/regression modelling approach in urban context." The abstract of the work developed was published in the proceedings of the conference (<https://ria.ua.pt/handle/10773/32855>). On the other hand, the simulation framework created by BSC was also presented at the virtual ECCOMAS Conference 2020 between the 11th and 15th of January 2020 (<http://wccm-eccomas2020.org/frontal/MSList.asp>). The presentation was titled "A new high-fidelity urban flow simulation framework." The work was an oral presentation and was further discussed within the "Numerical Advancements in Simulations of Environmental Flows" Mini symposium. The presentation was recorded and can be watched in the following link: <https://slideslive.com/38945856/a-new-highfidelity-urban-flow-simulation-framework>
- Presence in smart cities fairs: The action was disseminated being present in two Portuguese smart cities fairs: the Portugal Smart Cities Summit 2020 and in the [Portugal Smart Cities Summit 2021](#). In the Portugal Smart Cities Summit 2020 that was held in the Lisbon Congress Centre between the 22nd and 24th of September 2020, the project was present with a stand where several information (flyers) and videos were presented to people that attended to the fair. Also brainstorming sessions about each analytical model were conducted with live transmission in the NOVA Cidade – Urban Analytics Lab Facebook page. For the case of Portugal Smart Cities Summit 2021 that was held in the Lisbon International Fair between the 16th and 18th of November 2021, the analytical models of each use case were presented in an afternoon session in the stand of Lisbon City Council.
- Publication of scientific papers: The project was also disseminated through the publication of scientific papers. A work regarding the waste management model developed during the action titled the "[Impact of COVID-19 lockdown measures on waste production behaviour in Lisbon](#)" was published in [Waste Management journal](#). Also another paper regarding the parking use case was submitted to the journal [Case Studies on Transport Policy](#), being at this moment under review. Also the work developed for emergency use case and presented in the VI Conference on Regional and Urban Planning/ I Conference on Data Science for the Social Sciences/ Conference of the Research Project DRIVIT-UP, is being extended to be submitted to a journal.
- Participation in hackathons: The action was promoted with the presence in the [World Data League 2021](#) hackathon that was held between April and July 2021 online, providing support to the organization in developing two use cases similar to the ones that were developed in the framework of the project, namely the prediction of illegal parking and traffic accidents. Also, members of the consortium provided support as juris and mentors of the hackathon, and lecturing workshops to the participants.
- Interviews to magazines: to promote the action were also made interviews in magazines: [Smart Cities magazine](#)
- Newsletters: The action was mentioned in newsletters: [NOVA Cidade newsletter nº 6 \(October 2021\)](#), [NOVA Cidade newsletter nº 10 \(February 2022\)](#).
- Posts in social media channels: [NOVA Cidade Facebook page](#), [NOVA Cidade LinkedIn page](#).
- Videos: Videos posted in YouTube channels: [Urban Co-Creation Data Lab Channel 1](#); [Urban Co-Creation Data Lab Channel 2](#).

Photos of some of the activities mentioned above can be found in the [events page of the Action website](#).

4. OTHER SOURCES OF EUROPEAN UNION FUNDS

If applicable, provide information about other sources of EU funds (CEF, ERDF, Cohesion Fund, H2020, TEN, EEPR, EIPA, etc.) used for the action (including previous or subsequent phases not covered by the Grant Agreement).

The Action did not receive any other sources of European Union Funds.

5. COMPLIANCE WITH EU LEGISLATION

Where relevant, provide information on the compliance with EU legislation regarding other matters (notably public procurement, competition, regulatory matters, etc...).

Public procurement of the Action regarding NOVA IMS, CML and NECPT was made resorting to the Portuguese Public Contracting Code (CCP) [decree law nº 18/2008, of January 29](#). CCP proceeds to the transposition of European Directives nº 2004/17/CE e 2004/18/CE of the Council and European Parliament, of March 31, changed by the Directive nº 2005/51/CE, of the Commission, of September 7, and rectified by the Directive nº 2005/75/CE, of the European Parliament and Commission, of November 16.

Regarding BSC "Public procurement was carried out in compliance with the Law 9/2017, of 8 November, on Public Sector Contracts, transposing into Spanish law the Directives of the European Parliament and of the Council 2014/23/EU and 2014/24/EU of 26 February 2014. This law proceeds to the transposition of European Directives 2014/23/EU of 26 February 2014 on the award of concession contracts, an institution with a long legal tradition in Spanish law, and Directive 2014/24/EU of 26 February 2014 on public procurement."

6. COMPLIANCE WITH CORE PLATFORM AND POLICY OBJECTIVES

Information on the compliance with the core service, including conformity with relevant technical specifications and alignment with the policy objectives of the Digital Service Infrastructure (as specified in the relevant CEF Telecom Work Programme).

The overall objective of the Connecting Europe Facility (CEF) is to pursue economic growth and support the completion and functioning of the internal market in support of the competitiveness of the European economy. CEF Telecom is aimed at pursuing real improvements in daily life for citizens, businesses (including SMEs) and administrations through the deployment of solid trans-European interoperable infrastructures based on mature technical and organizational solutions. CEF focuses on providing operational services which are ready to be deployed and which will be sustainable and maintained over time.

The Action alignment with the CEF Telecom policy objectives is connected through the development and deployment of analytical models in a city council, providing a solution to improve public administration operations (in this case at city level) that consequently can be translated in benefits in daily life for citizens at the same it gives an effective contribution to the digital and green transition leaving no one behind. This has today a new relevance, since Lisbon is one of the 100 European cities that is part of the Mission Smart and Climate Neutral Cities having to become neutral in carbon emission by 2030 and data-driven approaches to public policy making are mandatory for the success of the ambition.

More concretely the deployment of the analytical model of micromobility to estimate bike docks occupation ratio brings benefits for Lisbon City Council in two different dimensions:

1. It can provide valuable information for the daily operations and management of the available docks in the bike stations of the docked bike sharing service in Lisbon (GIRA service), allowing:
 - a. A better management of bike docks rebalancing, in which the costs associated with this operation can be reduced
 - b. Citizens have a more positive experience with the service as the efficiency of rebalancing is improved (i.e., citizens that use the service have more access to available bikes or empty docks to park a bike)
2. Provide valuable information for the bike stations network expansion, through the knowledge acquired about the bike stations with more or less demand

Also, the other models where developed and can be implemented providing benefits to Lisbon City Council:

- Waste management: the Urban Hygiene Department can optimize their waste collection logistic reducing costs and carbon footprint due to waste collection operations
- Parking: Municipality Police can simulate accordingly with environmental and city characteristics the risk of illegal parking and dispatch more efficiently police officers for illegal parking control
- Emergency: Firefighters and city managers can simulate the impacts that the modification in road characteristics have in the risk of traffic accidents, contributing to a better city roads planning. Also, the extension of the model integrating environmental characteristics can provide information about the locations where the emergency response time is more reduced

The micromobility model was deployed in the Lisbon Intelligent Management Platform (PGIL) - an integrative platform capable of receiving and handling a large volume of real time data. PGIL is a middleware open-source platform based on Cloud City Operation Centre (CCOC) solution developed by NEC, which is fully aligned and certified by the FIWARE standards. It also provides the necessary technological tools that can guarantee, allied with relevant HR the maintenance and sustainability of the analytical model in the Lisbon City Council.

The Action results are aligned with the Digital Service Infrastructure (DSI) of Access to re-usable public sector information – Public Open Data. The objective of this DSI is to help boost the development of information products and services based on the re-use and combination of data held by public and commercial actors across the EU. The Core Service Platform has been deployed through the development of the [European Data Portal](#). Operational since November 2015, the portal has been harvesting the metadata of Public Sector Information made available by public data portals across Europe. Regarding the generic services the call of the Action addressed three themes:

- 1) support for the re-use of information made discoverable/available through the European Data Portal;
- 2) generation of cross-border services providing access (view and download) to harmonized thematic open dataset(s) and the corresponding metadata;
- 3) creation of new access services to increase the HPC and data capacities of the European Data Infrastructure.

The generated datasets from the action are being made available in [Lisbon Open Data Portal](#) along with their metadata, to be harvested by the [Portuguese Open Data Portal](#) and consequently by the European Data Portal. At the moment of the final report the compliance with metadata quality requirements of the European Data Portal is being evaluated for the resulting datasets of the Action. The availability of the resulting datasets and analytical models in a national portal and harvested by the

European will allow the reuse of data and analytical models in different geographic contexts, also allowing the sustainability of the project in the long term. For the development of the pollution use case were used HPC resources that allowed the leverage of use of HPC for the development of services and solutions for the public administration, in the context of the Action to the Lisbon City Council.

ANNEX: Financial statement