“This project has received funding from the European Union’s Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 813884”.

Project Number: 813884

Project Acronym: Lowcomote

Project title: Training the Next Generation of Experts in Scalable Low-Code Engineering Platforms

NETWORK WEB PRESENCE

Project GA: 813884

Project Acronym: Lowcomote

Project website: https://www.lowcomote.eu/

Project officer: Mercedes Leguey-Jimenez

Work Package: WP6

Deliverable number: D6.1.

Production date: 26/06/2019

Contractual date of delivery: 30/06/2019

Actual date of delivery: 26/06/2019

Dissemination level: Public

Lead beneficiary: Intecs

Authors: Marie Chastanet & Silvia Mazzini

HISTORY OF CHANGES		
Version	**Publication date**	**Change**
1.0	26/06/2019	▪ Initial version

Project Abstract

Low-code development platforms (LCPD) are software development platforms on the Cloud, provided through a Platform-as a-Service model, which allow users to build completely operational applications by interacting through dynamic graphical user interfaces, visual diagrams and declarative languages. They address the need of non-programmers to develop personalised software, and focus on their domain expertise instead of implementation requirements.

Lowcomote will train a generation of experts that will upgrade the current trend of LCPDs to a new paradigm, Low-code Engineering Platforms (LCEPs). LCEPs will be open, allowing to integrate heterogeneous engineering tools, interoperable, allowing for cross-platform engineering, scalable, supporting very large engineering models and social networks of developers, smart, simplifying the development for citizen developers by machine learning and recommendation techniques. This will be achieved by injecting in LCDPs the theoretical and technical framework defined by recent research in Model Driven Engineering (MDE), augmented with Cloud Computing and Machine Learning techniques. This is possible today thanks to recent breakthroughs in scalability of MDE performed in the EC FP7 research project MONDO, led by Lowcomote partners.

The 48-month Lowcomote project will train the first European generation of skilled professionals in LCEPs. The 15 future scientists will benefit from an original training and research programme merging competencies and knowledge from 5 highly recognised academic institutions and 9 large and small industries of several domains. Co-supervision from both sectors is a promising process to facilitate agility of our future professionals between the academic and industrial world.

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Introduction

The present document is a deliverable of the Lowcomote project (Grant Agreement n°813884), funded by the European Commission Research Executive Agency (REA), under the Innovative Training Networks Programme of the Marie Sklodowska Curie Actions (H2020-MSCA-ITN-2018). The purpose of this document is to describe the content of the project's website, and to detail the content of its sections and its architecture.

1. Description of the Deliverable

The web presence of Lowcomote consists in a project website and social media accounts.

The website of Lowcomote project intends to describe objectives, approach, participants involved and expected results of the project. It will be the main communication tool of consortium's partners and Early Stage Researchers' (ESR) all along the project's life cycle.

Regular updates will be made accordingly by all partners, including ESRs, especially when announcing workshops, conferences, other visibility events, and uploading articles and public deliverables. The website has also been designed as the main entry point of recruitment of ESRs. The structure of the website has been conceived accordingly.

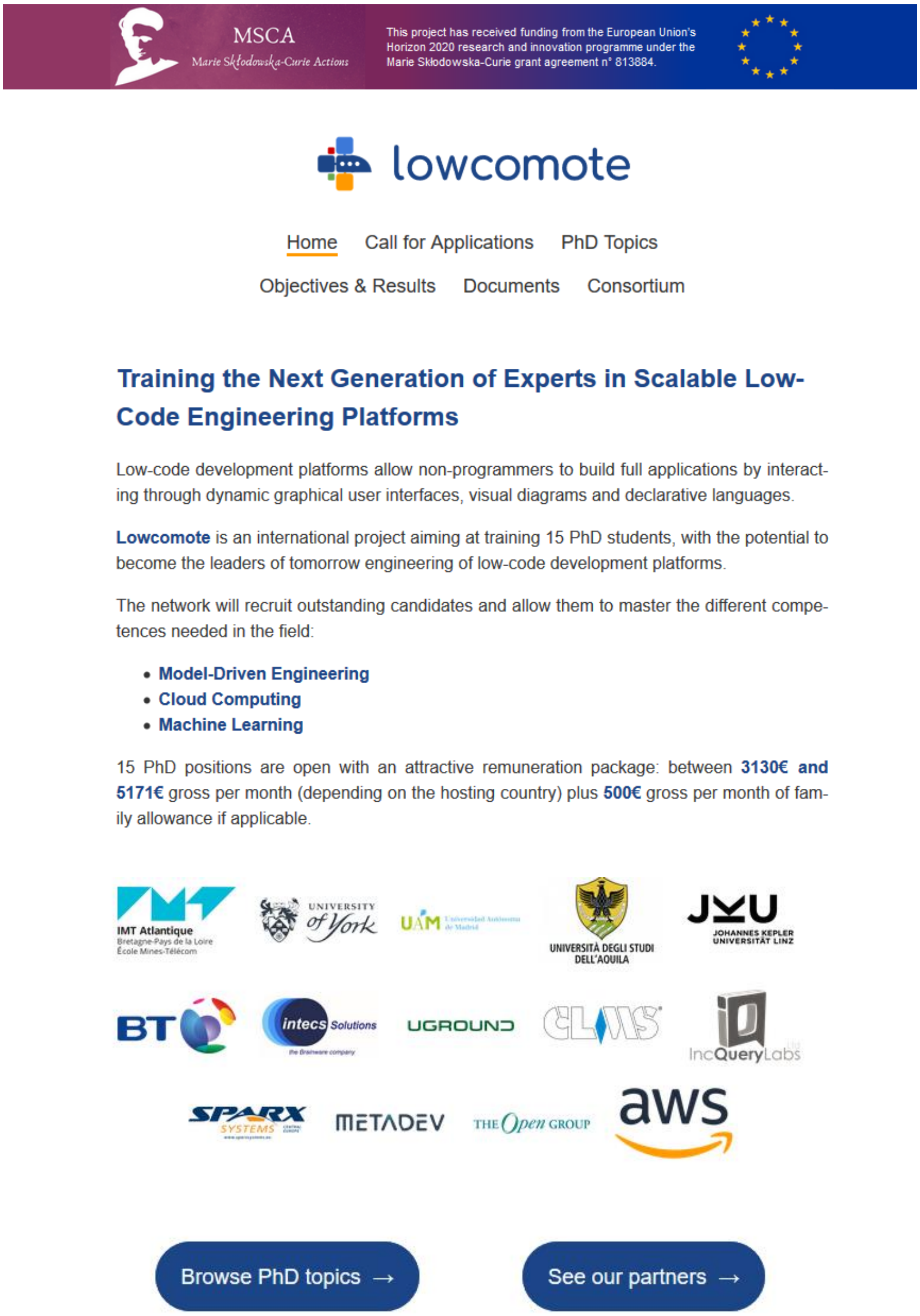
2. Structure of the website

The website is currently composed of a home page, a call for applications page, 15 PhD topic pages, an objectives & results page, a documents page, consortium page and a legal notice page. Content of each page is detailed in the following sections.

NB: all along the project, the structure of the website might evolve with the communication needs and in accordance with the consortium's communication strategy and betterment of its visual identity. Namely, a news page will be created to highlight the project's major events and the current structure might evolve. The following sections describe the situation at the time of drafting of the report.

2. 1. Home Page

The page provides basic information about the project and main hiring conditions for ESRs.



This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement n° 813884.

Training the Next Generation of Experts in Scalable Low-Code Engineering Platforms

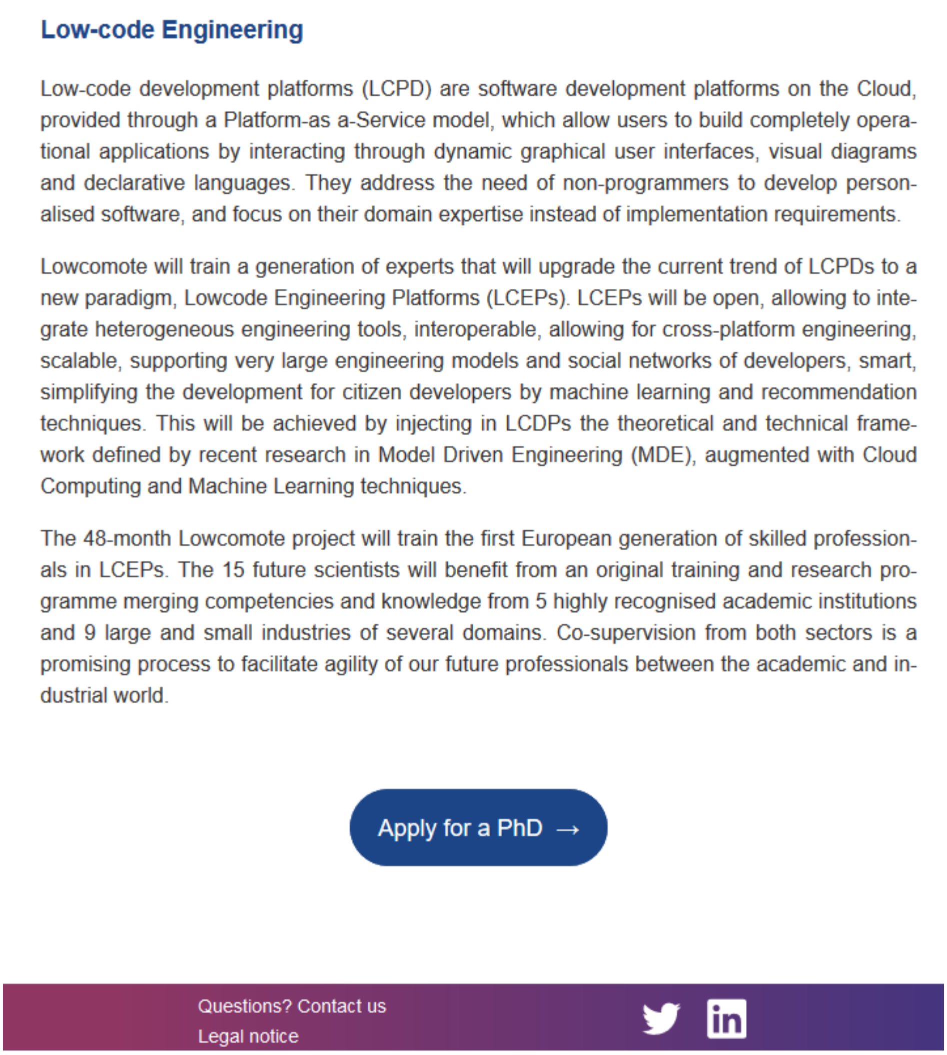
Low-code development platforms allow non-programmers to build full applications by interacting through dynamic graphical user interfaces, visual diagrams and declarative languages.

Lowcomote is an international project aiming at training 15 PhD students, with the potential to become the leaders of tomorrow engineering of low-code development platforms.

The network will recruit outstanding candidates and allow them to master the different competences needed in the field:

- **Model-Driven Engineering**
- **Cloud Computing**
- **Machine Learning**

15 PhD positions are open with an attractive remuneration package: between **3130€ and 5171€** gross per month (depending on the hosting country) plus **500€** gross per month of family allowance if applicable.



Low-code Engineering

Low-code development platforms (LCPD) are software development platforms on the Cloud, provided through a Platform-as a-Service model, which allow users to build completely operational applications by interacting through dynamic graphical user interfaces, visual diagrams and declarative languages. They address the need of non-programmers to develop personalised software, and focus on their domain expertise instead of implementation requirements.

Lowcomote will train a generation of experts that will upgrade the current trend of LCPDs to a new paradigm, Lowcode Engineering Platforms (LCEPs). LCEPs will be open, allowing to integrate heterogeneous engineering tools, interoperable, allowing for cross-platform engineering, scalable, supporting very large engineering models and social networks of developers, smart, simplifying the development for citizen developers by machine learning and recommendation techniques. This will be achieved by injecting in LCDPs the theoretical and technical framework defined by recent research in Model Driven Engineering (MDE), augmented with Cloud Computing and Machine Learning techniques.

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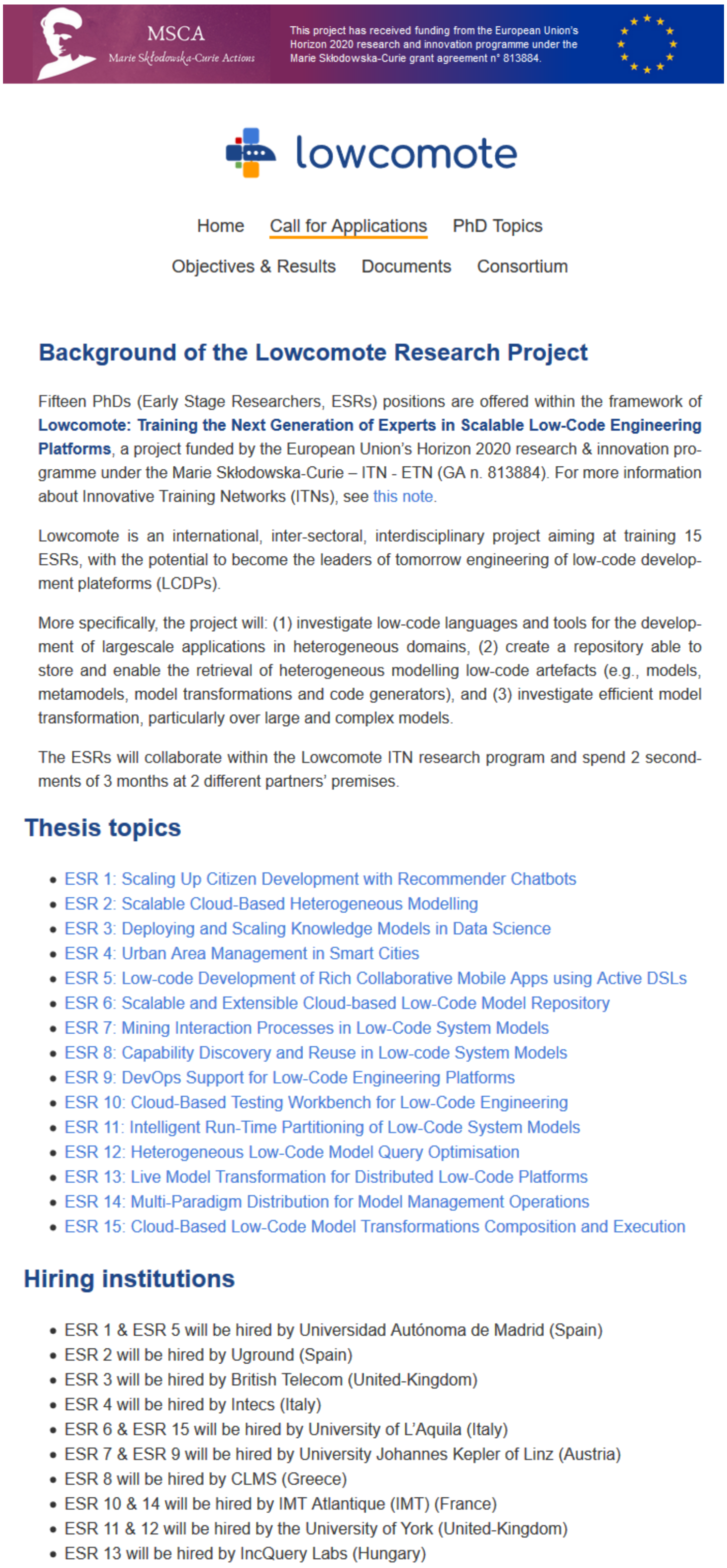
Figure 1 – Home Page

2.2. Call for applications

This page details the hiring conditions for ESRs, Innovative Training Network eligibility criteria and recruitment process related information.


MSCA
Marie Skłodowska-Curie Actions
This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement n° 813884.
lowcomote
Home
Call for Applications
PhD Topics
Objectives & Results
Documents
Consortium

Background of the Lowcomote Research Project

Fifteen PhDs (Early Stage Researchers, ESRs) positions are offered within the framework of **Lowcomote: Training the Next Generation of Experts in Scalable Low-Code Engineering Platforms**, a project funded by the European Union's Horizon 2020 research & innovation programme under the Marie Skłodowska-Curie – ITN - ETN (GA n. 813884). For more information about Innovative Training Networks (ITNs), see this note.

Lowcomote is an international, inter-sectoral, interdisciplinary project aiming at training 15 ESRs, with the potential to become the leaders of tomorrow engineering of low-code development plateforms (LCDPs).

More specifically, the project will: (1) investigate low-code languages and tools for the development of largescale applications in heterogeneous domains, (2) create a repository able to store and enable the retrieval of heterogeneous modelling low-code artefacts (e.g., models, metamodels, model transformations and code generators), and (3) investigate efficient model transformation, particularly over large and complex models.

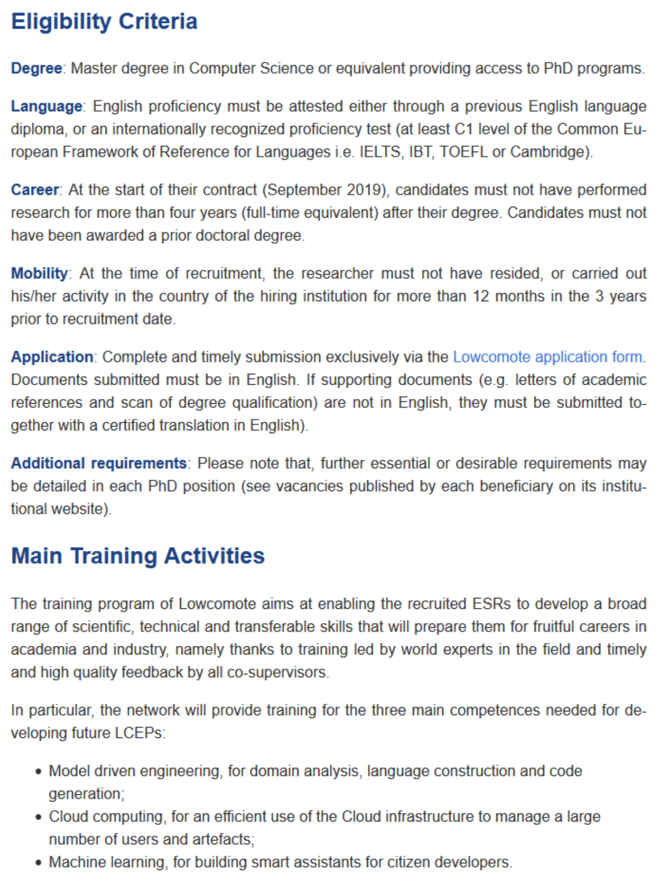
The ESRs will collaborate within the Lowcomote ITN research program and spend 2 secondments of 3 months at 2 different partners' premises.

Thesis topics

- ESR 1: Scaling Up Citizen Development with Recommender Chatbots
- ESR 2: Scalable Cloud-Based Heterogeneous Modelling
- ESR 3: Deploying and Scaling Knowledge Models in Data Science
- ESR 4: Urban Area Management in Smart Cities
- ESR 5: Low-code Development of Rich Collaborative Mobile Apps using Active DSLs
- ESR 6: Scalable and Extensible Cloud-based Low-Code Model Repository
- ESR 7: Mining Interaction Processes in Low-Code System Models
- ESR 8: Capability Discovery and Reuse in Low-code System Models
- ESR 9: DevOps Support for Low-Code Engineering Platforms
- ESR 10: Cloud-Based Testing Workbench for Low-Code Engineering
- ESR 11: Intelligent Run-Time Partitioning of Low-Code System Models
- ESR 12: Heterogeneous Low-Code Model Query Optimisation
- ESR 13: Live Model Transformation for Distributed Low-Code Platforms
- ESR 14: Multi-Paradigm Distribution for Model Management Operations
- ESR 15: Cloud-Based Low-Code Model Transformations Composition and Execution

Hiring institutions

- ESR 1 & ESR 5 will be hired by Universidad Autónoma de Madrid (Spain)
- ESR 2 will be hired by Uground (Spain)
- ESR 3 will be hired by British Telecom (United-Kingdom)
- ESR 4 will be hired by Intecs (Italy)
- ESR 6 & ESR 15 will be hired by University of L'Aquila (Italy)
- ESR 7 & ESR 9 will be hired by University Johannes Kepler of Linz (Austria)
- ESR 8 will be hired by CLMS (Greece)
- ESR 10 & 14 will be hired by IMT Atlantique (IMT) (France)
- ESR 11 & 12 will be hired by the University of York (United-Kingdom)
- ESR 13 will be hired by IncQuery Labs (Hungary)



Eligibility Criteria

Degree: Master degree in Computer Science or equivalent providing access to PhD programs.

Language: English proficiency must be attested either through a previous English language diploma, or an internationally recognized proficiency test (at least C1 level of the Common European Framework of Reference for Languages i.e. IELTS, IBT, TOEFL or Cambridge).

Career: At the start of their contract (September 2019), candidates must not have performed research for more than four years (full-time equivalent) after their degree. Candidates must not have been awarded a prior doctoral degree.

Mobility: At the time of recruitment, the researcher must not have resided, or carried out his/her activity in the country of the hiring institution for more than 12 months in the 3 years prior to recruitment date.

Application: Complete and timely submission exclusively via the Lowcomote application form. Documents submitted must be in English. If supporting documents (e.g. letters of academic references and scan of degree qualification) are not in English, they must be submitted together with a certified translation in English).

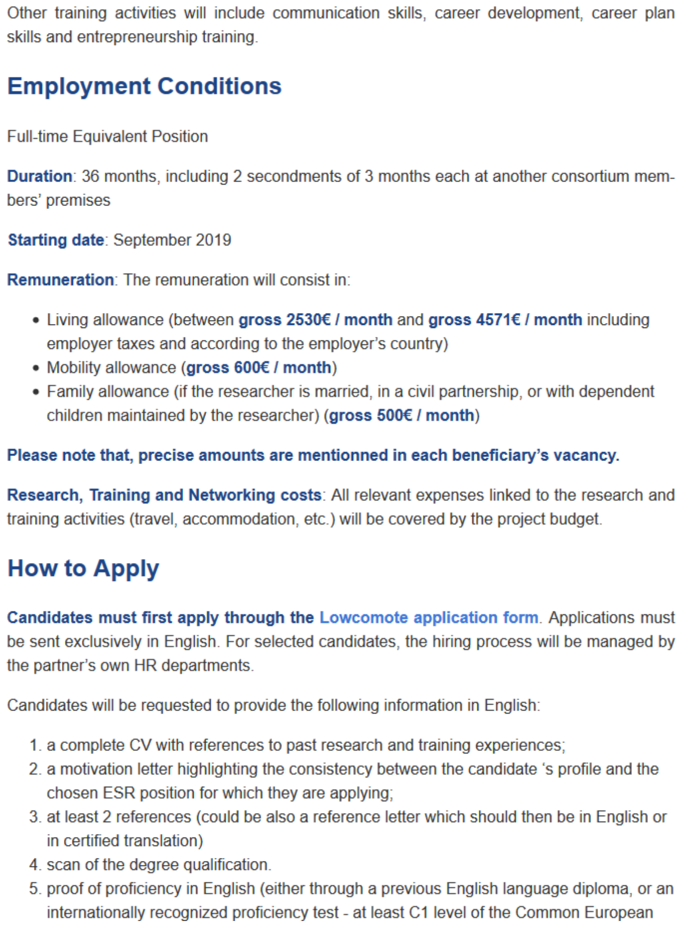
Additional requirements: Please note that, further essential or desirable requirements may be detailed in each PhD position (see vacancies published by each beneficiary on its institutional website).

Main Training Activities

The training program of Lowcomote aims at enabling the recruited ESRs to develop a broad range of scientific, technical and transferable skills that will prepare them for fruitful careers in academia and industry, namely thanks to training led by world experts in the field and timely and high quality feedback by all co-supervisors.

In particular, the network will provide training for the three main competences needed for developing future LCEPs:

- Model driven engineering, for domain analysis, language construction and code generation;
- Cloud computing, for an efficient use of the Cloud infrastructure to manage a large number of users and artefacts;
- Machine learning, for building smart assistants for citizen developers.



Other training activities will include communication skills, career development, career plan skills and entrepreneurship training.

Employment Conditions

Full-time Equivalent Position

Duration: 36 months, including 2 secondments of 3 months each at another consortium members' premises

Starting date: September 2019

Remuneration: The remuneration will consist in:

- Living allowance (between **gross 2530€ / month** and **gross 4571€ / month** including employer taxes and according to the employer's country)
- Mobility allowance (**gross 600€ / month**)
- Family allowance (if the researcher is married, in a civil partnership, or with dependent children maintained by the researcher) (**gross 500€ / month**)

Please note that, precise amounts are mentionned in each beneficiary's vacancy.

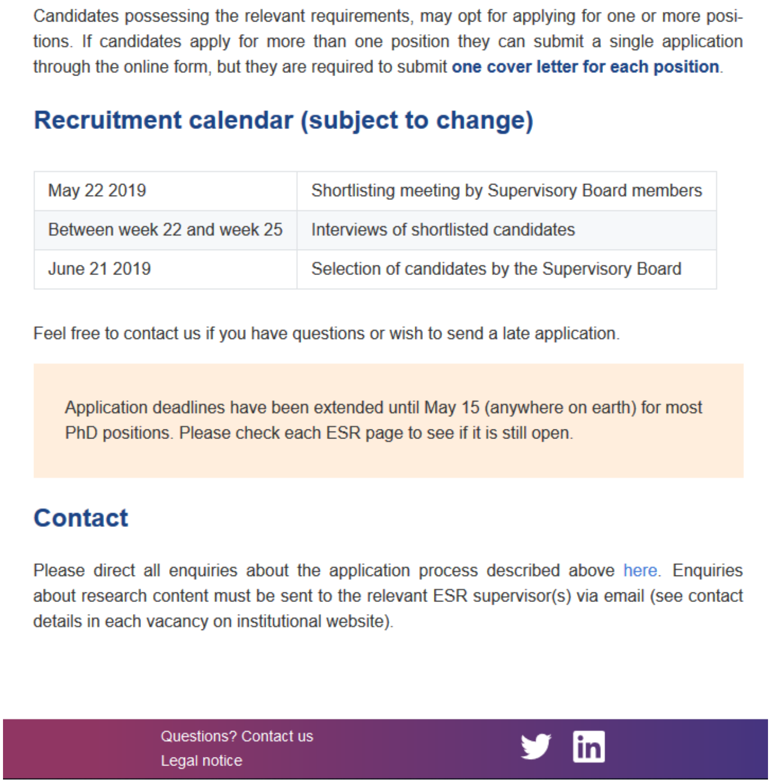
Research, Training and Networking costs: All relevant expenses linked to the research and training activities (travel, accommodation, etc.) will be covered by the project budget.

How to Apply

Candidates must first apply through the Lowcomote application form. Applications must be sent exclusively in English. For selected candidates, the hiring process will be managed by the partner's own HR departments.

Candidates will be requested to provide the following information in English:

1. a complete CV with references to past research and training experiences;
2. a motivation letter highlighting the consistency between the candidate 's profile and the chosen ESR position for which they are applying;
3. at least 2 references (could be also a reference letter which should then be in English or in certified translation)
4. scan of the degree qualification.
5. proof of proficiency in English (either through a previous English language diploma, or an internationally recognized proficiency test - at least C1 level of the Common European



Candidates possessing the relevant requirements, may opt for applying for one or more positions. If candidates apply for more than one position they can submit a single application through the online form, but they are required to submit **one cover letter for each position**.

Recruitment calendar (subject to change)

May 22 2019	Shortlisting meeting by Supervisory Board members
Between week 22 and week 25	Interviews of shortlisted candidates
June 21 2019	Selection of candidates by the Supervisory Board

Feel free to contact us if you have questions or wish to send a late application.

Application deadlines have been extended until May 15 (anywhere on earth) for most PhD positions. Please check each ESR page to see if it is still open.

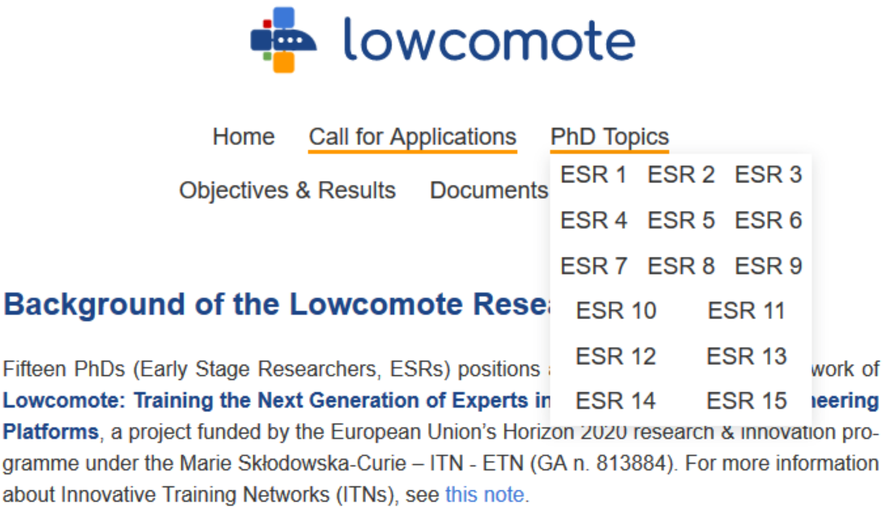
Contact

Please direct all enquiries about the application process described above here. Enquiries about research content must be sent to the relevant ESR supervisor(s) via email (see contact details in each vacancy on institutional website).

Figure 2 – Call for application page

2.3. Pages for each PhD topic

A pull-down menu enables to access each PhD topic with background, expected results, vacancy of each beneficiary, and access to the application form.



Background of the Lowcomote Rese

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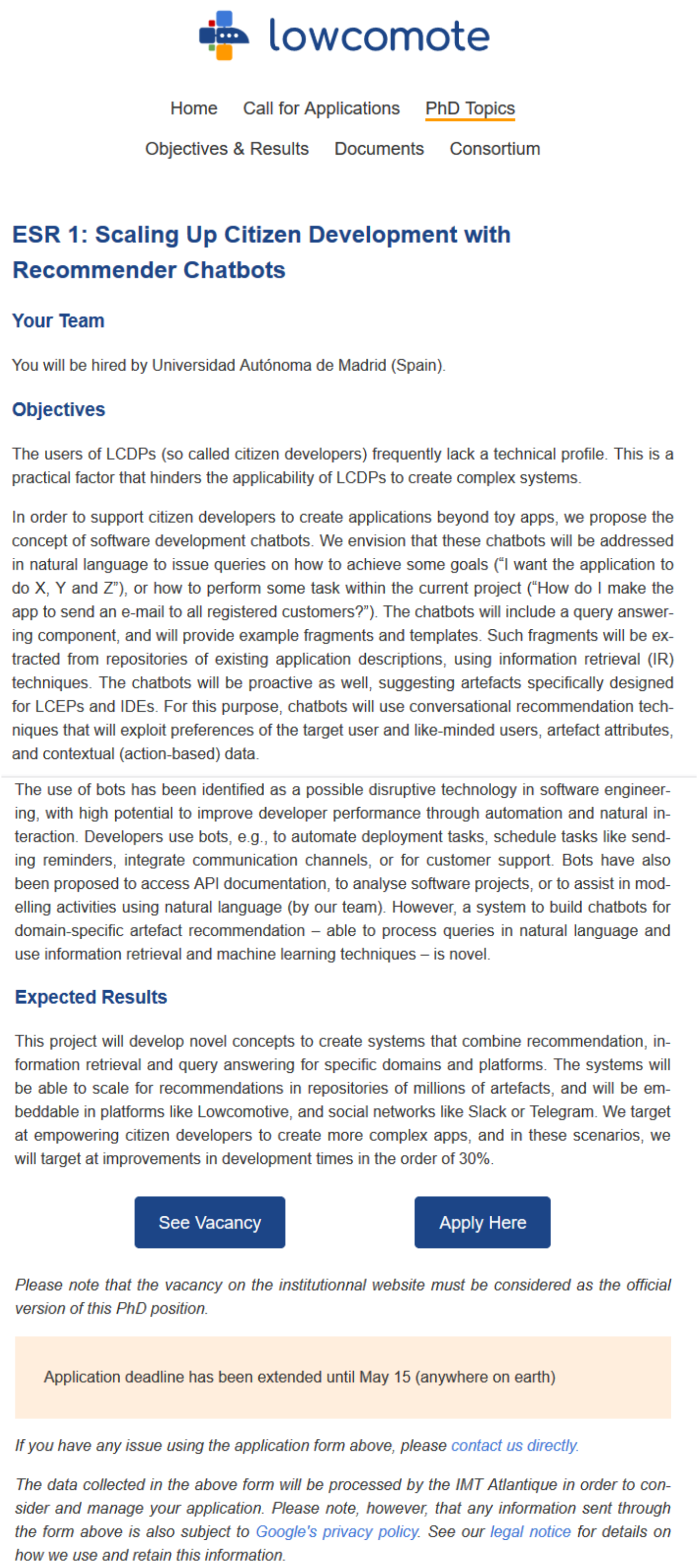
Figure 3 – Pull-down menu to access PhD topics pages



ESR 1: Scaling Up Citizen Development with Recommender Chatbots

Your Team

You will be hired by Universidad Autónoma de Madrid (Spain).

Objectives

The users of LCDPs (so called citizen developers) frequently lack a technical profile. This is a practical factor that hinders the applicability of LCDPs to create complex systems.

In order to support citizen developers to create applications beyond toy apps, we propose the concept of software development chatbots. We envision that these chatbots will be addressed in natural language to issue queries on how to achieve some goals ("I want the application to do X, Y and Z"), or how to perform some task within the current project ("How do I make the app to send an e-mail to all registered customers?"). The chatbots will include a query answering component, and will provide example fragments and templates. Such fragments will be extracted from repositories of existing application descriptions, using information retrieval (IR) techniques. The chatbots will be proactive as well, suggesting artefacts specifically designed for LCEPs and IDEs. For this purpose, chatbots will use conversational recommendation techniques that will exploit preferences of the target user and like-minded users, artefact attributes, and contextual (action-based) data.

The use of bots has been identified as a possible disruptive technology in software engineering, with high potential to improve developer performance through automation and natural interaction. Developers use bots, e.g., to automate deployment tasks, schedule tasks like sending reminders, integrate communication channels, or for customer support. Bots have also been proposed to access API documentation, to analyse software projects, or to assist in modelling activities using natural language (by our team). However, a system to build chatbots for domain-specific artefact recommendation – able to process queries in natural language and use information retrieval and machine learning techniques – is novel.

Expected Results

This project will develop novel concepts to create systems that combine recommendation, information retrieval and query answering for specific domains and platforms. The systems will be able to scale for recommendations in repositories of millions of artefacts, and will be embeddable in platforms like Lowcomotive, and social networks like Slack or Telegram. We target at empowering citizen developers to create more complex apps, and in these scenarios, we will target at improvements in development times in the order of 30%.

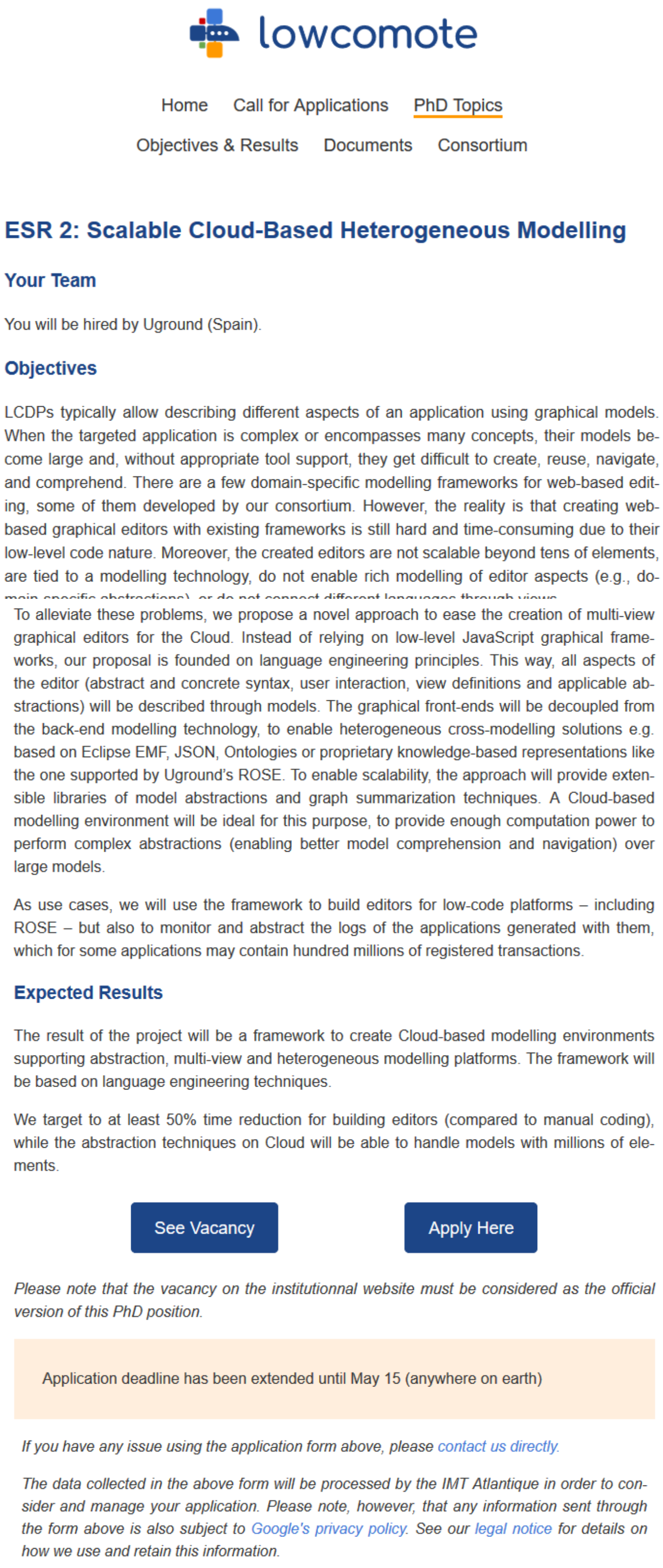
Please note that the vacancy on the institutionnal website must be considered as the official version of this PhD position.

Application deadline has been extended until May 15 (anywhere on earth)

If you have any issue using the application form above, please contact us directly.

The data collected in the above form will be processed by the IMT Atlantique in order to consider and manage your application. Please note, however, that any information sent through the form above is also subject to Google's privacy policy. See our legal notice for details on how we use and retain this information.

Figure 4 – ESR 1 page



ESR 2: Scalable Cloud-Based Heterogeneous Modelling

Your Team

You will be hired by Uground (Spain).

Objectives

LCDPs typically allow describing different aspects of an application using graphical models. When the targeted application is complex or encompasses many concepts, their models become large and, without appropriate tool support, they get difficult to create, reuse, navigate, and comprehend. There are a few domain-specific modelling frameworks for web-based editing, some of them developed by our consortium. However, the reality is that creating web-based graphical editors with existing frameworks is still hard and time-consuming due to their low-level code nature. Moreover, the created editors are not scalable beyond tens of elements, are tied to a modelling technology, do not enable rich modelling of editor aspects (e.g., domain-specific abstractions), or do not connect different languages through views.

To alleviate these problems, we propose a novel approach to ease the creation of multi-view graphical editors for the Cloud. Instead of relying on low-level JavaScript graphical frameworks, our proposal is founded on language engineering principles. This way, all aspects of the editor (abstract and concrete syntax, user interaction, view definitions and applicable abstractions) will be described through models. The graphical front-ends will be decoupled from the back-end modelling technology, to enable heterogeneous cross-modelling solutions e.g. based on Eclipse EMF, JSON, Ontologies or proprietary knowledge-based representations like the one supported by Uground's ROSE. To enable scalability, the approach will provide extensible libraries of model abstractions and graph summarization techniques. A Cloud-based modelling environment will be ideal for this purpose, to provide enough computation power to perform complex abstractions (enabling better model comprehension and navigation) over large models.

As use cases, we will use the framework to build editors for low-code platforms – including ROSE – but also to monitor and abstract the logs of the applications generated with them, which for some applications may contain hundred millions of registered transactions.

Expected Results

The result of the project will be a framework to create Cloud-based modelling environments supporting abstraction, multi-view and heterogeneous modelling platforms. The framework will be based on language engineering techniques.

We target to at least 50% time reduction for building editors (compared to manual coding), while the abstraction techniques on Cloud will be able to handle models with millions of elements.

Please note that the vacancy on the institutionnal website must be considered as the official version of this PhD position.

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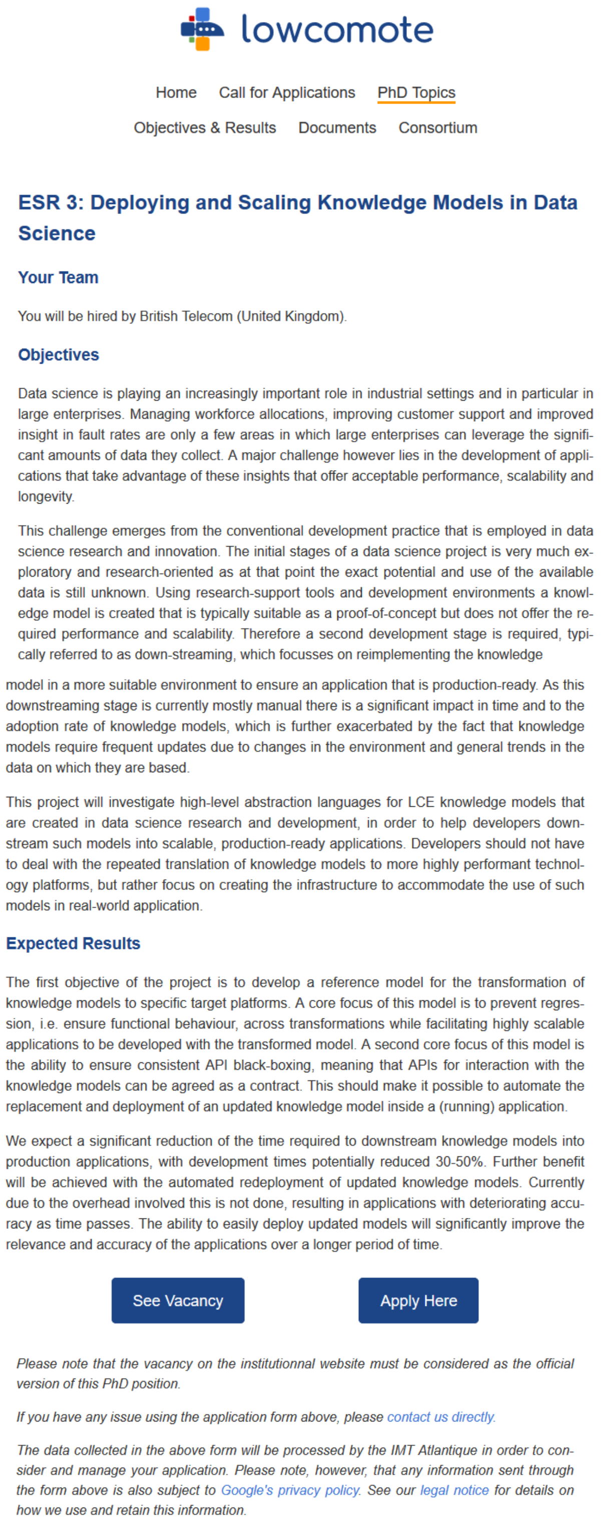
Figure 5 – ESR 2 page



ESR 3: Deploying and Scaling Knowledge Models in Data Science

Your Team

You will be hired by British Telecom (United Kingdom).

Objectives

Data science is playing an increasingly important role in industrial settings and in particular in large enterprises. Managing workforce allocations, improving customer support and improved insight in fault rates are only a few areas in which large enterprises can leverage the significant amounts of data they collect. A major challenge however lies in the development of applications that take advantage of these insights that offer acceptable performance, scalability and longevity.

This challenge emerges from the conventional development practice that is employed in data science research and innovation. The initial stages of a data science project is very much exploratory and research-oriented as at that point the exact potential and use of the available data is still unknown. Using research-support tools and development environments a knowledge model is created that is typically suitable as a proof-of-concept but does not offer the required performance and scalability. Therefore a second development stage is required, typically referred to as down-streaming, which focusses on reimplementing the knowledge model in a more suitable environment to ensure an application that is production-ready. As this downstreaming stage is currently mostly manual there is a significant impact in time and to the adoption rate of knowledge models, which is further exacerbated by the fact that knowledge models require frequent updates due to changes in the environment and general trends in the data on which they are based.

This project will investigate high-level abstraction languages for LCE knowledge models that are created in data science research and development, in order to help developers downstream such models into scalable, production-ready applications. Developers should not have to deal with the repeated translation of knowledge models to more highly performant technology platforms, but rather focus on creating the infrastructure to accommodate the use of such models in real-world application.

Expected Results

The first objective of the project is to develop a reference model for the transformation of knowledge models to specific target platforms. A core focus of this model is to prevent regression, i.e. ensure functional behaviour, across transformations while facilitating highly scalable applications to be developed with the transformed model. A second core focus of this model is the ability to ensure consistent API black-boxing, meaning that APIs for interaction with the knowledge models can be agreed as a contract. This should make it possible to automate the replacement and deployment of an updated knowledge model inside a (running) application.

We expect a significant reduction of the time required to downstream knowledge models into production applications, with development times potentially reduced 30-50%. Further benefit will be achieved with the automated redeployment of updated knowledge models. Currently due to the overhead involved this is not done, resulting in applications with deteriorating accuracy as time passes. The ability to easily deploy updated models will significantly improve the relevance and accuracy of the applications over a longer period of time.

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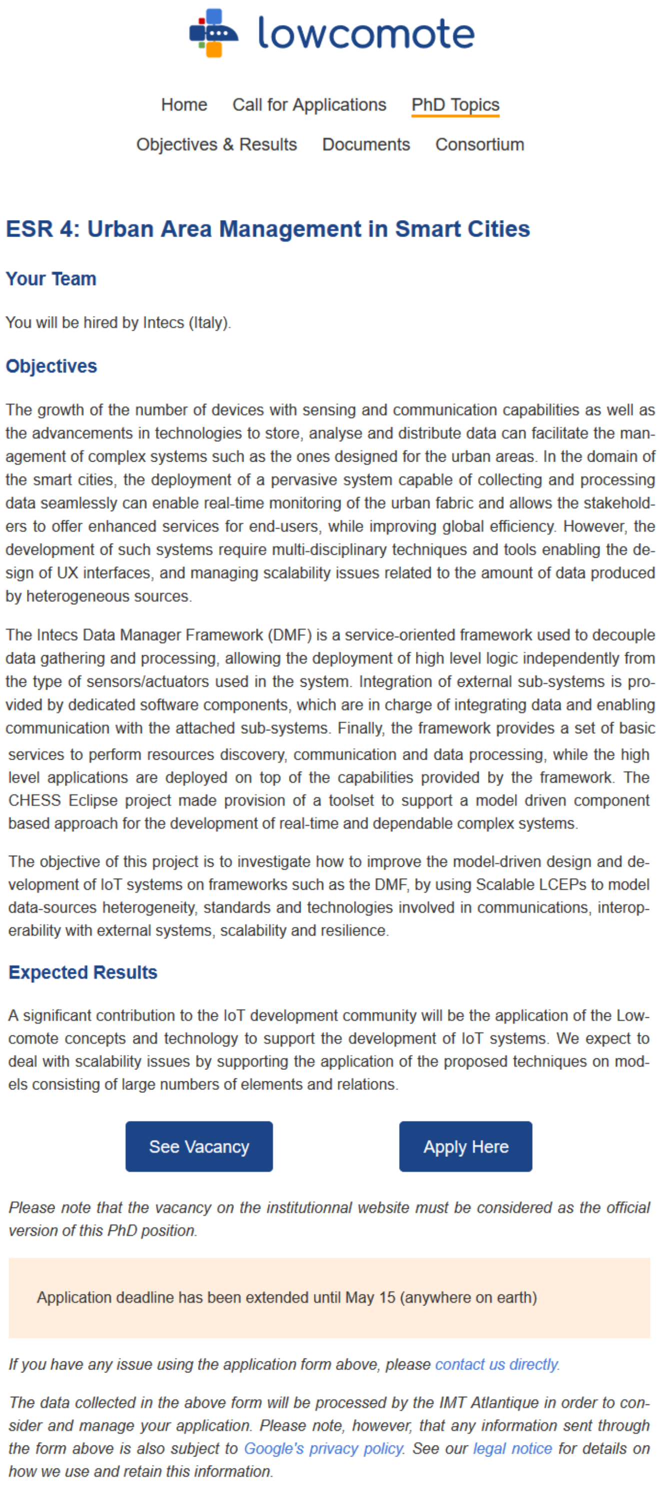
Figure 6 – ESR3 page



ESR 4: Urban Area Management in Smart Cities

Your Team

You will be hired by Intecs (Italy).

Objectives

The growth of the number of devices with sensing and communication capabilities as well as the advancements in technologies to store, analyse and distribute data can facilitate the management of complex systems such as the ones designed for the urban areas. In the domain of the smart cities, the deployment of a pervasive system capable of collecting and processing data seamlessly can enable real-time monitoring of the urban fabric and allows the stakeholders to offer enhanced services for end-users, while improving global efficiency. However, the development of such systems require multi-disciplinary techniques and tools enabling the design of UX interfaces, and managing scalability issues related to the amount of data produced by heterogeneous sources.

The Intecs Data Manager Framework (DMF) is a service-oriented framework used to decouple data gathering and processing, allowing the deployment of high level logic independently from the type of sensors/actuators used in the system. Integration of external sub-systems is provided by dedicated software components, which are in charge of integrating data and enabling communication with the attached sub-systems. Finally, the framework provides a set of basic services to perform resources discovery, communication and data processing, while the high level applications are deployed on top of the capabilities provided by the framework. The CHESS Eclipse project made provision of a toolset to support a model driven component based approach for the development of real-time and dependable complex systems.

The objective of this project is to investigate how to improve the model-driven design and development of IoT systems on frameworks such as the DMF, by using Scalable LCEPs to model data-sources heterogeneity, standards and technologies involved in communications, interoperability with external systems, scalability and resilience.

Expected Results

A significant contribution to the IoT development community will be the application of the Lowcomote concepts and technology to support the development of IoT systems. We expect to deal with scalability issues by supporting the application of the proposed techniques on models consisting of large numbers of elements and relations.

Please note that the vacancy on the institutionnal website must be considered as the official version of this PhD position.

Application deadline has been extended until May 15 (anywhere on earth)

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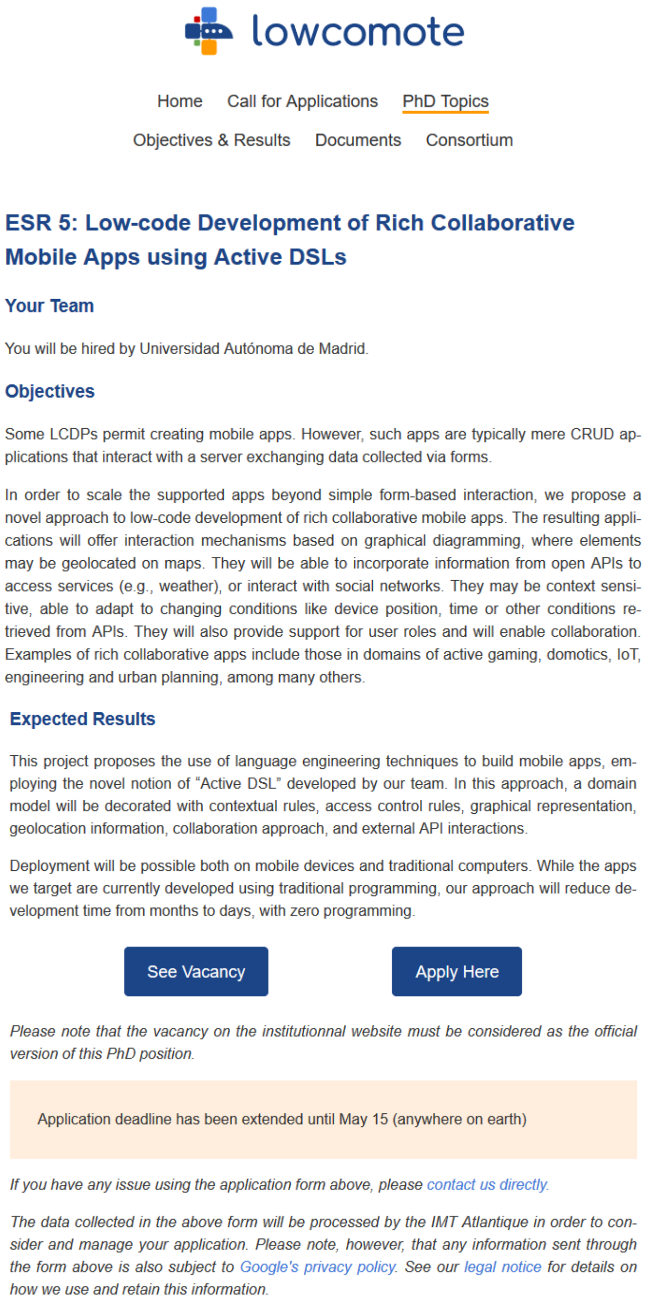
Figure 7 – ESR 4 page



ESR 5: Low-code Development of Rich Collaborative Mobile Apps using Active DSLs

Your Team

You will be hired by Universidad Autónoma de Madrid.

Objectives

Some LCDPs permit creating mobile apps. However, such apps are typically mere CRUD applications that interact with a server exchanging data collected via forms.

In order to scale the supported apps beyond simple form-based interaction, we propose a novel approach to low-code development of rich collaborative mobile apps. The resulting applications will offer interaction mechanisms based on graphical diagramming, where elements may be geolocated on maps. They will be able to incorporate information from open APIs to access services (e.g., weather), or interact with social networks. They may be context sensitive, able to adapt to changing conditions like device position, time or other conditions retrieved from APIs. They will also provide support for user roles and will enable collaboration. Examples of rich collaborative apps include those in domains of active gaming, domotics, IoT, engineering and urban planning, among many others.

Expected Results

This project proposes the use of language engineering techniques to build mobile apps, employing the novel notion of "Active DSL" developed by our team. In this approach, a domain model will be decorated with contextual rules, access control rules, graphical representation, geolocation information, collaboration approach, and external API interactions.

Deployment will be possible both on mobile devices and traditional computers. While the apps we target are currently developed using traditional programming, our approach will reduce development time from months to days, with zero programming.

Please note that the vacancy on the institutionnal website must be considered as the official version of this PhD position.

Application deadline has been extended until May 15 (anywhere on earth)

If you have any issue using the application form above, please contact us directly.

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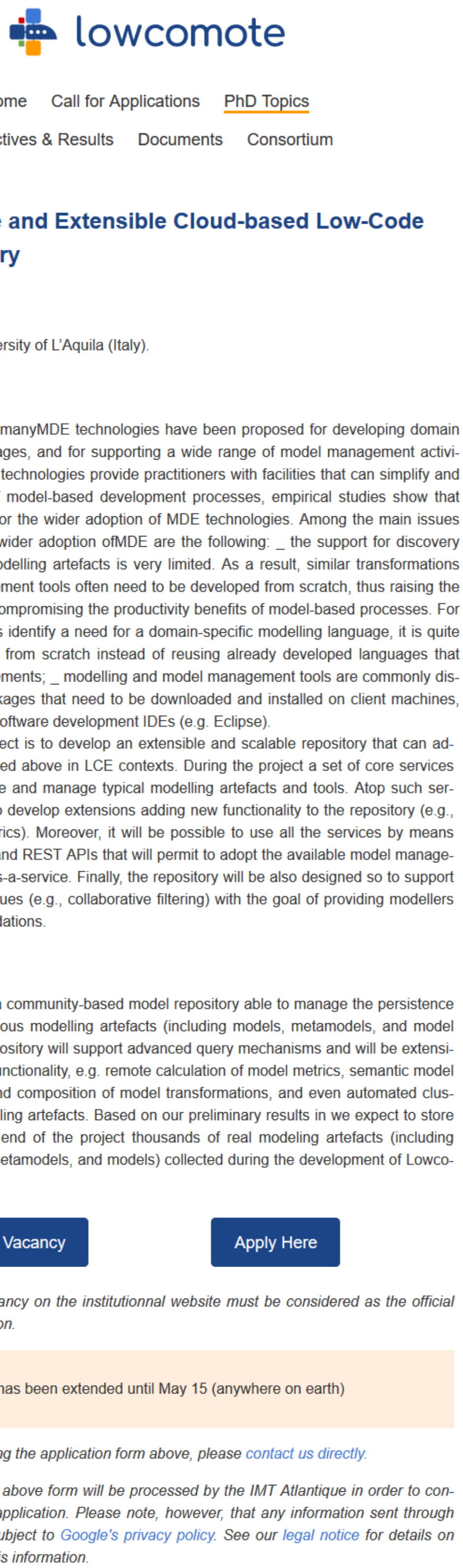
Figure 8 – ESR 5 page



ESR 6: Scalable and Extensible Cloud-based Low-Code Model Repository

Your Team

You will be hired by University of L'Aquila (Italy).

Objectives

Over the last few years, manyMDE technologies have been proposed for developing domain specific modelling languages, and for supporting a wide range of model management activities. While existing MDE technologies provide practitioners with facilities that can simplify and automate many steps of model-based development processes, empirical studies show that some barriers still exist for the wider adoption of MDE technologies. Among the main issues that currently hamper a wider adoption ofMDE are the following: _ the support for discovery and reuse of existing modelling artefacts is very limited. As a result, similar transformations and other model management tools often need to be developed from scratch, thus raising the upfront investment and compromising the productivity benefits of model-based processes. For instance, when modellers identify a need for a domain-specific modelling language, it is quite common to implement it from scratch instead of reusing already developed languages that might satisfy their requirements; _ modelling and model management tools are commonly distributed as software packages that need to be downloaded and installed on client machines, often on top of complex software development IDEs (e.g. Eclipse).
The objective of this project is to develop an extensible and scalable repository that can address the issues mentioned above in LCE contexts. During the project a set of core services will be developed to store and manage typical modelling artefacts and tools. Atop such services it will be possible to develop extensions adding new functionality to the repository (e.g., calculation of model metrics). Moreover, it will be possible to use all the services by means through a web interface and REST APIs that will permit to adopt the available model management tools as software-as-a-service. Finally, the repository will be also designed so to support machine learning techniques (e.g., collaborative filtering) with the goal of providing modellers with real-time recommendations.

Expected Results

The project will develop a community-based model repository able to manage the persistence and reuse of heterogeneous modelling artefacts (including models, metamodels, and model transformations). The repository will support advanced query mechanisms and will be extensible in order to add new functionality, e.g. remote calculation of model metrics, semantic model differencing, validation and composition of model transformations, and even automated clustering of the stored modeling artefacts. Based on our preliminary results in we expect to store in the repository by the end of the project thousands of real modeling artefacts (including model transformations, metamodels, and models) collected during the development of Lowcomote.

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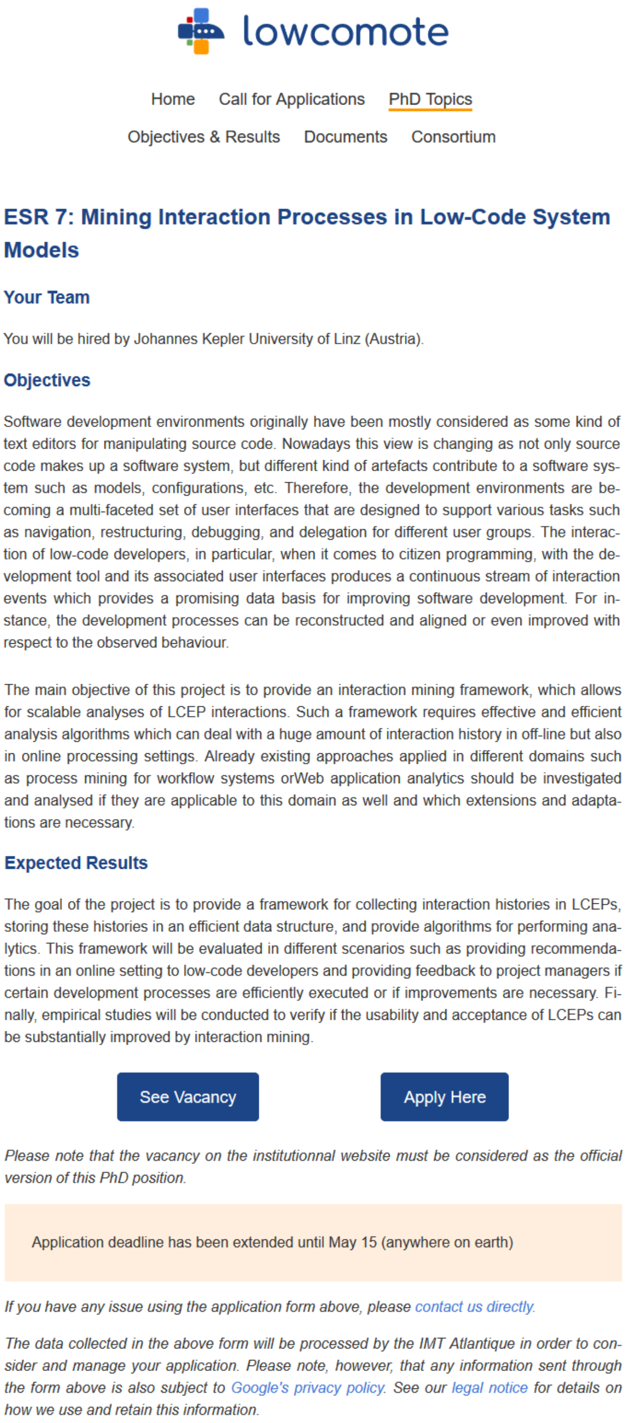
Figure 9 – ESR 6 page



ESR 7: Mining Interaction Processes in Low-Code System Models

Your Team

You will be hired by Johannes Kepler University of Linz (Austria).

Objectives

Software development environments originally have been mostly considered as some kind of text editors for manipulating source code. Nowadays this view is changing as not only source code makes up a software system, but different kind of artefacts contribute to a software system such as models, configurations, etc. Therefore, the development environments are becoming a multi-faceted set of user interfaces that are designed to support various tasks such as navigation, restructuring, debugging, and delegation for different user groups. The interaction of low-code developers, in particular, when it comes to citizen programming, with the development tool and its associated user interfaces produces a continuous stream of interaction events which provides a promising data basis for improving software development. For instance, the development processes can be reconstructed and aligned or even improved with respect to the observed behaviour.

The main objective of this project is to provide an interaction mining framework, which allows for scalable analyses of LCEP interactions. Such a framework requires effective and efficient analysis algorithms which can deal with a huge amount of interaction history in off-line but also in online processing settings. Already existing approaches applied in different domains such as process mining for workflow systems orWeb application analytics should be investigated and analysed if they are applicable to this domain as well and which extensions and adaptations are necessary.

Expected Results

The goal of the project is to provide a framework for collecting interaction histories in LCEPs, storing these histories in an efficient data structure, and provide algorithms for performing analytics. This framework will be evaluated in different scenarios such as providing recommendations in an online setting to low-code developers and providing feedback to project managers if certain development processes are efficiently executed or if improvements are necessary. Finally, empirical studies will be conducted to verify if the usability and acceptance of LCEPs can be substantially improved by interaction mining.

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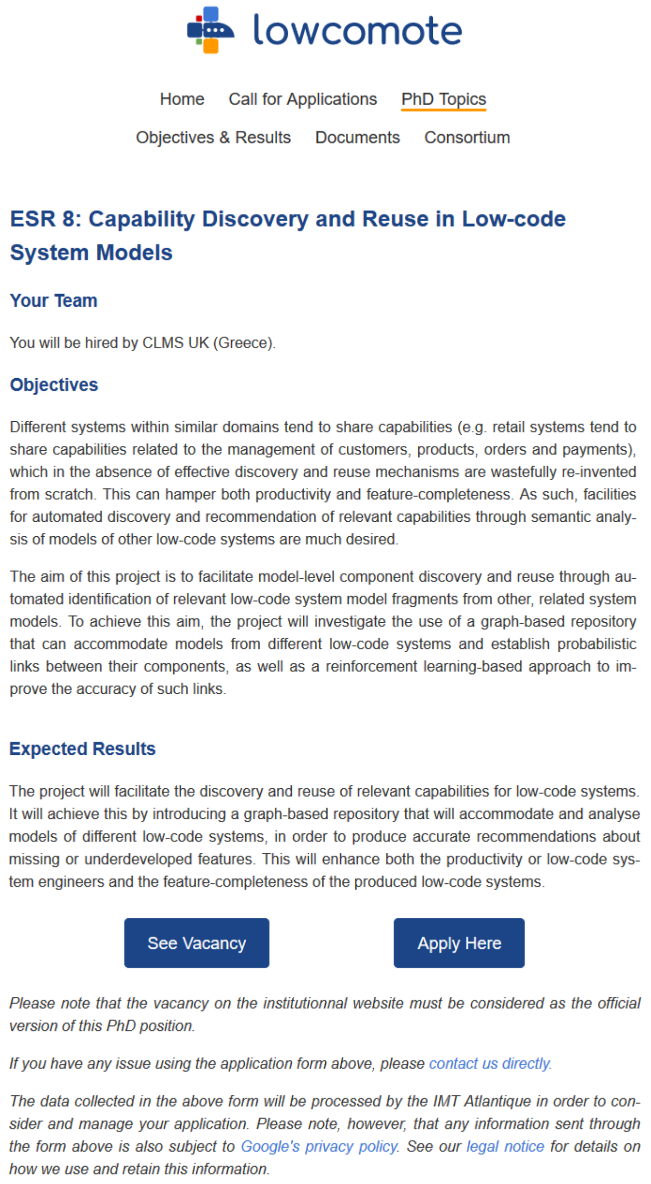
Figure 10 – ESR 7 page



ESR 8: Capability Discovery and Reuse in Low-code System Models

Your Team

You will be hired by CLMS UK (Greece).

Objectives

Different systems within similar domains tend to share capabilities (e.g. retail systems tend to share capabilities related to the management of customers, products, orders and payments), which in the absence of effective discovery and reuse mechanisms are wastefully re-invented from scratch. This can hamper both productivity and feature-completeness. As such, facilities for automated discovery and recommendation of relevant capabilities through semantic analysis of models of other low-code systems are much desired.

The aim of this project is to facilitate model-level component discovery and reuse through automated identification of relevant low-code system model fragments from other, related system models. To achieve this aim, the project will investigate the use of a graph-based repository that can accommodate models from different low-code systems and establish probabilistic links between their components, as well as a reinforcement learning-based approach to improve the accuracy of such links.

Expected Results

The project will facilitate the discovery and reuse of relevant capabilities for low-code systems. It will achieve this by introducing a graph-based repository that will accommodate and analyse models of different low-code systems, in order to produce accurate recommendations about missing or underdeveloped features. This will enhance both the productivity or low-code system engineers and the feature-completeness of the produced low-code systems.

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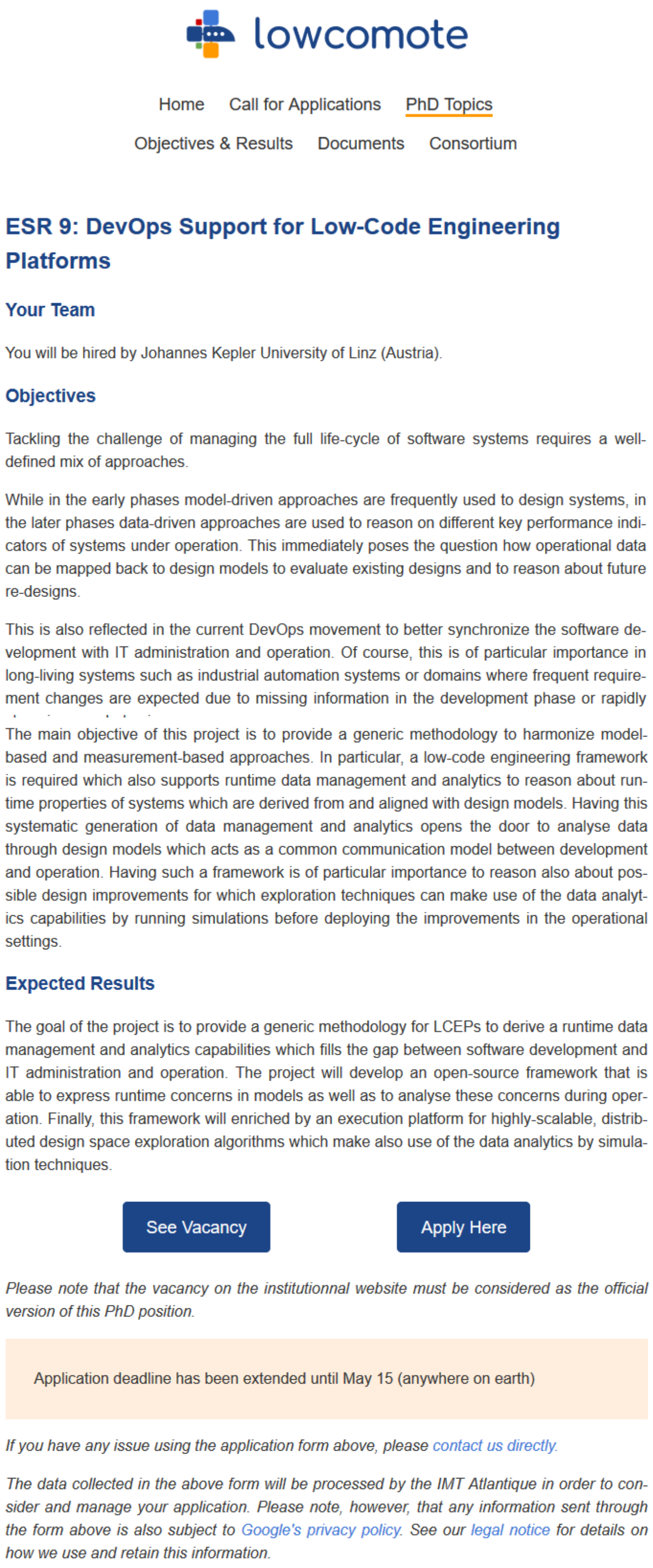
Figure 11 – ESR 8 page



ESR 9: DevOps Support for Low-Code Engineering Platforms

Your Team

You will be hired by Johannes Kepler University of Linz (Austria).

Objectives

Tackling the challenge of managing the full life-cycle of software systems requires a well-defined mix of approaches.

While in the early phases model-driven approaches are frequently used to design systems, in the later phases data-driven approaches are used to reason on different key performance indicators of systems under operation. This immediately poses the question how operational data can be mapped back to design models to evaluate existing designs and to reason about future re-designs.

This is also reflected in the current DevOps movement to better synchronize the software development with IT administration and operation. Of course, this is of particular importance in long-living systems such as industrial automation systems or domains where frequent requirement changes are expected due to missing information in the development phase or rapidly

The main objective of this project is to provide a generic methodology to harmonize model-based and measurement-based approaches. In particular, a low-code engineering framework is required which also supports runtime data management and analytics to reason about runtime properties of systems which are derived from and aligned with design models. Having this systematic generation of data management and analytics opens the door to analyse data through design models which acts as a common communication model between development and operation. Having such a framework is of particular importance to reason also about possible design improvements for which exploration techniques can make use of the data analytics capabilities by running simulations before deploying the improvements in the operational settings.

Expected Results

The goal of the project is to provide a generic methodology for LCEPs to derive a runtime data management and analytics capabilities which fills the gap between software development and IT administration and operation. The project will develop an open-source framework that is able to express runtime concerns in models as well as to analyse these concerns during operation. Finally, this framework will enriched by an execution platform for highly-scalable, distributed design space exploration algorithms which make also use of the data analytics by simulation techniques.

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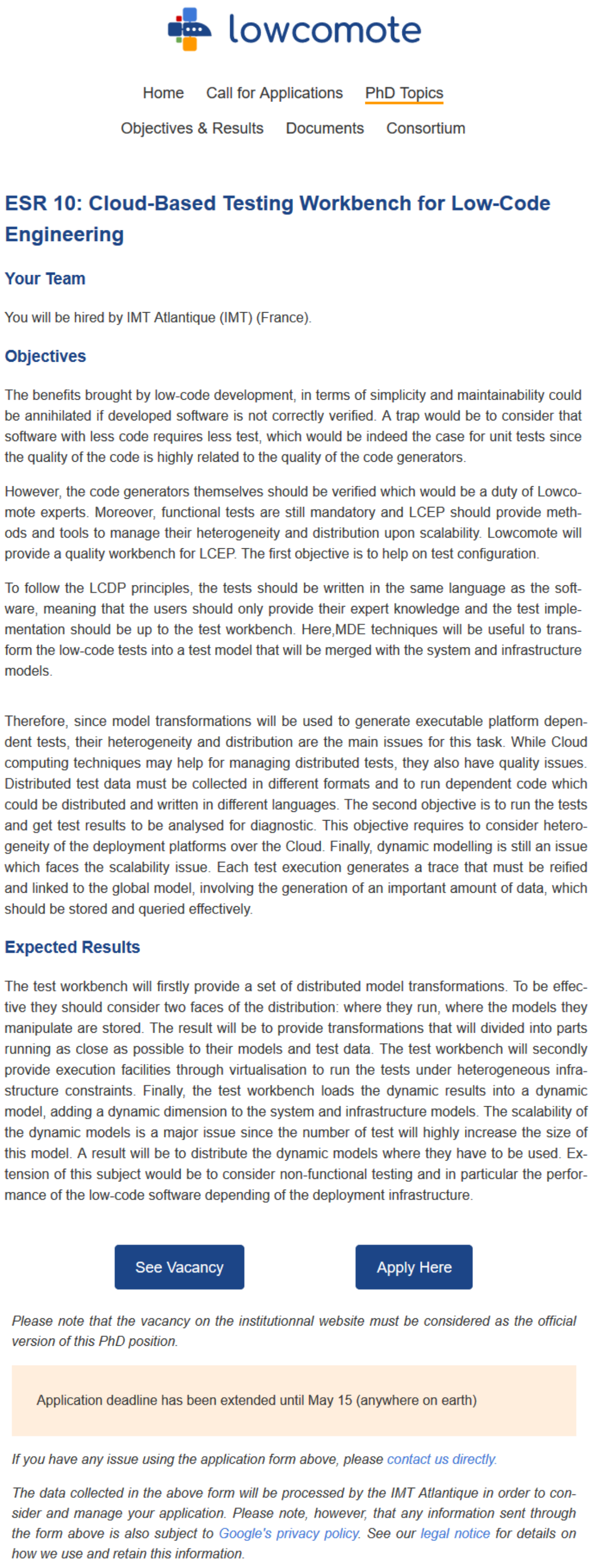
Figure 12 – ESR 9 page



ESR 10: Cloud-Based Testing Workbench for Low-Code Engineering

Your Team

You will be hired by IMT Atlantique (IMT) (France).

Objectives

The benefits brought by low-code development, in terms of simplicity and maintainability could be annihilated if developed software is not correctly verified. A trap would be to consider that software with less code requires less test, which would be indeed the case for unit tests since the quality of the code is highly related to the quality of the code generators.

However, the code generators themselves should be verified which would be a duty of Lowcomote experts. Moreover, functional tests are still mandatory and LCEP should provide methods and tools to manage their heterogeneity and distribution upon scalability. Lowcomote will provide a quality workbench for LCEP. The first objective is to help on test configuration.

To follow the LCDP principles, the tests should be written in the same language as the software, meaning that the users should only provide their expert knowledge and the test implementation should be up to the test workbench. Here,MDE techniques will be useful to transform the low-code tests into a test model that will be merged with the system and infrastructure models.

Therefore, since model transformations will be used to generate executable platform dependent tests, their heterogeneity and distribution are the main issues for this task. While Cloud computing techniques may help for managing distributed tests, they also have quality issues. Distributed test data must be collected in different formats and to run dependent code which could be distributed and written in different languages. The second objective is to run the tests and get test results to be analysed for diagnostic. This objective requires to consider heterogeneity of the deployment platforms over the Cloud. Finally, dynamic modelling is still an issue which faces the scalability issue. Each test execution generates a trace that must be reified and linked to the global model, involving the generation of an important amount of data, which should be stored and queried effectively.

Expected Results

The test workbench will firstly provide a set of distributed model transformations. To be effective they should consider two faces of the distribution: where they run, where the models they manipulate are stored. The result will be to provide transformations that will divided into parts running as close as possible to their models and test data. The test workbench will secondly provide execution facilities through virtualisation to run the tests under heterogeneous infrastructure constraints. Finally, the test workbench loads the dynamic results into a dynamic model, adding a dynamic dimension to the system and infrastructure models. The scalability of the dynamic models is a major issue since the number of test will highly increase the size of this model. A result will be to distribute the dynamic models where they have to be used. Extension of this subject would be to consider non-functional testing and in particular the performance of the low-code software depending of the deployment infrastructure.

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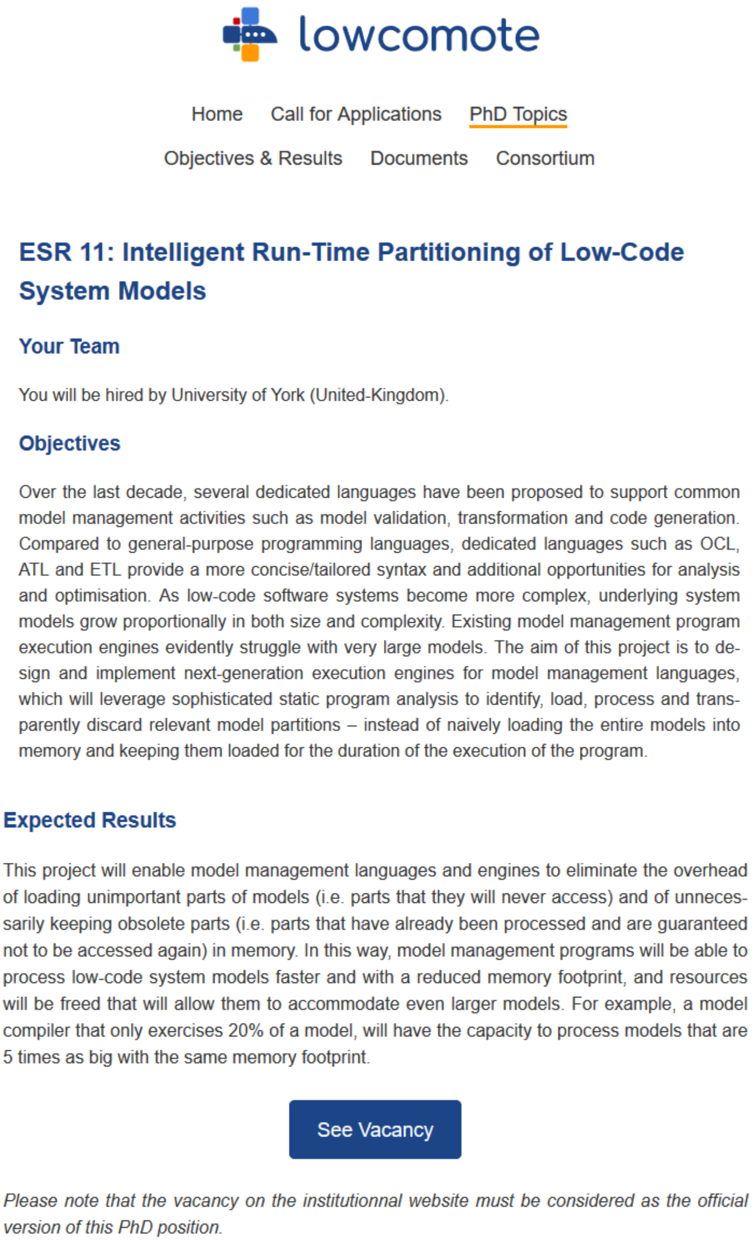
Figure 13 – ESR 10 page



ESR 11: Intelligent Run-Time Partitioning of Low-Code System Models

Your Team

You will be hired by University of York (United-Kingdom).

Objectives

Over the last decade, several dedicated languages have been proposed to support common model management activities such as model validation, transformation and code generation. Compared to general-purpose programming languages, dedicated languages such as OCL, ATL and ETL provide a more concise/tailored syntax and additional opportunities for analysis and optimisation. As low-code software systems become more complex, underlying system models grow proportionally in both size and complexity. Existing model management program execution engines evidently struggle with very large models. The aim of this project is to design and implement next-generation execution engines for model management languages, which will leverage sophisticated static program analysis to identify, load, process and transparently discard relevant model partitions – instead of naively loading the entire models into memory and keeping them loaded for the duration of the execution of the program.

Expected Results

This project will enable model management languages and engines to eliminate the overhead of loading unimportant parts of models (i.e. parts that they will never access) and of unnecessarily keeping obsolete parts (i.e. parts that have already been processed and are guaranteed not to be accessed again) in memory. In this way, model management programs will be able to process low-code system models faster and with a reduced memory footprint, and resources will be freed that will allow them to accommodate even larger models. For example, a model compiler that only exercises 20% of a model, will have the capacity to process models that are 5 times as big with the same memory footprint.

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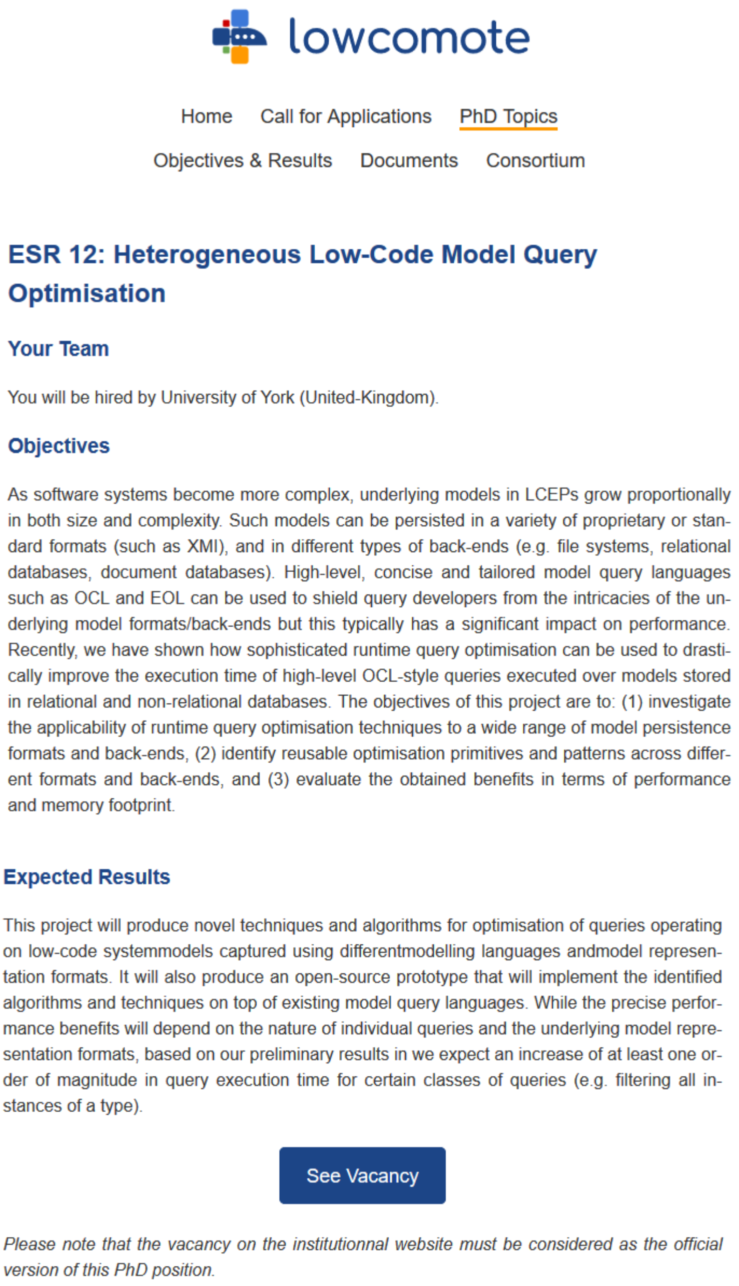
Figure 14 – ESR 11 page



ESR 12: Heterogeneous Low-Code Model Query Optimisation

Your Team

You will be hired by University of York (United-Kingdom).

Objectives

As software systems become more complex, underlying models in LCEPs grow proportionally in both size and complexity. Such models can be persisted in a variety of proprietary or standard formats (such as XMI), and in different types of back-ends (e.g. file systems, relational databases, document databases). High-level, concise and tailored model query languages such as OCL and EOL can be used to shield query developers from the intricacies of the underlying model formats/back-ends but this typically has a significant impact on performance. Recently, we have shown how sophisticated runtime query optimisation can be used to drastically improve the execution time of high-level OCL-style queries executed over models stored in relational and non-relational databases. The objectives of this project are to: (1) investigate the applicability of runtime query optimisation techniques to a wide range of model persistence formats and back-ends, (2) identify reusable optimisation primitives and patterns across different formats and back-ends, and (3) evaluate the obtained benefits in terms of performance and memory footprint.

Expected Results

This project will produce novel techniques and algorithms for optimisation of queries operating on low-code systemmodels captured using differentmodelling languages andmodel representation formats. It will also produce an open-source prototype that will implement the identified algorithms and techniques on top of existing model query languages. While the precise performance benefits will depend on the nature of individual queries and the underlying model representation formats, based on our preliminary results in we expect an increase of at least one order of magnitude in query execution time for certain classes of queries (e.g. filtering all instances of a type).

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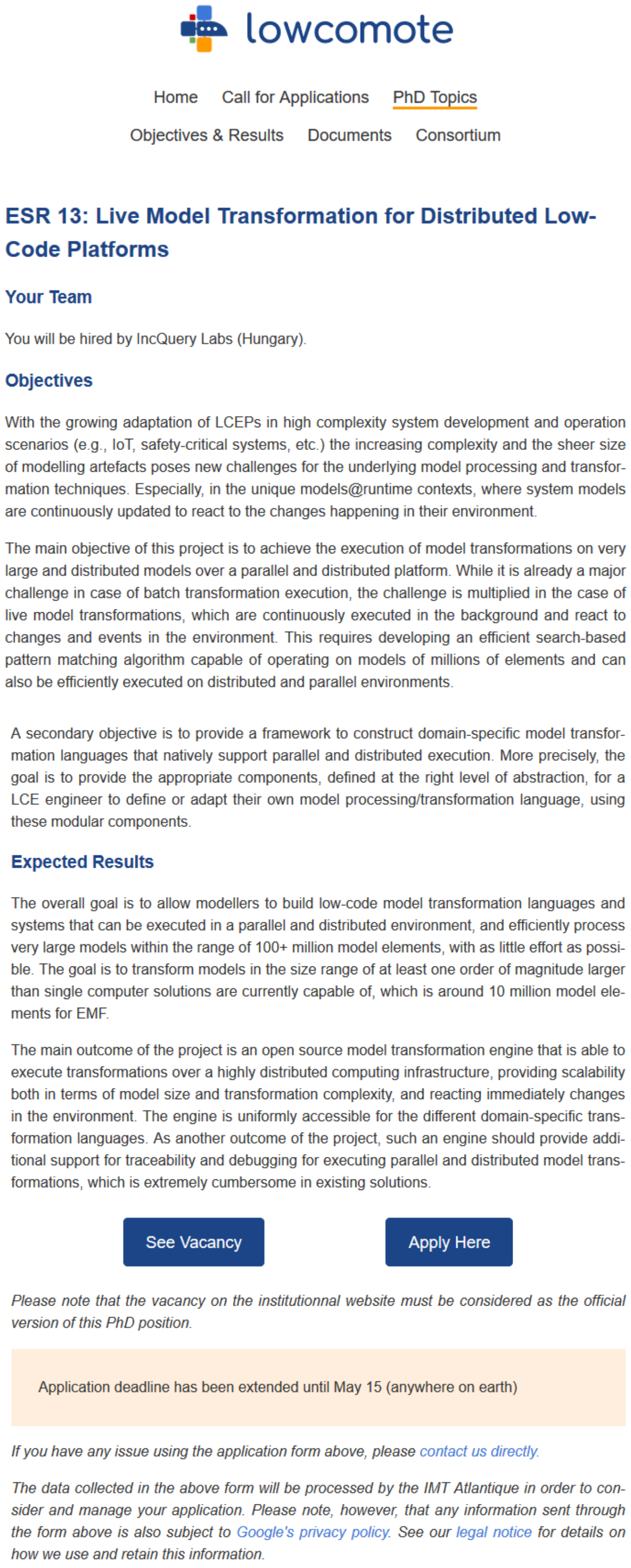
Figure 15 – ESR 12 page



ESR 13: Live Model Transformation for Distributed Low-Code Platforms

Your Team

You will be hired by IncQuery Labs (Hungary).

Objectives

With the growing adaptation of LCEPs in high complexity system development and operation scenarios (e.g., IoT, safety-critical systems, etc.) the increasing complexity and the sheer size of modelling artefacts poses new challenges for the underlying model processing and transformation techniques. Especially, in the unique models@runtime contexts, where system models are continuously updated to react to the changes happening in their environment.

The main objective of this project is to achieve the execution of model transformations on very large and distributed models over a parallel and distributed platform. While it is already a major challenge in case of batch transformation execution, the challenge is multiplied in the case of live model transformations, which are continuously executed in the background and react to changes and events in the environment. This requires developing an efficient search-based pattern matching algorithm capable of operating on models of millions of elements and can also be efficiently executed on distributed and parallel environments.

A secondary objective is to provide a framework to construct domain-specific model transformation languages that natively support parallel and distributed execution. More precisely, the goal is to provide the appropriate components, defined at the right level of abstraction, for a LCE engineer to define or adapt their own model processing/transformation language, using these modular components.

Expected Results

The overall goal is to allow modellers to build low-code model transformation languages and systems that can be executed in a parallel and distributed environment, and efficiently process very large models within the range of 100+ million model elements, with as little effort as possible. The goal is to transform models in the size range of at least one order of magnitude larger than single computer solutions are currently capable of, which is around 10 million model elements for EMF.

The main outcome of the project is an open source model transformation engine that is able to execute transformations over a highly distributed computing infrastructure, providing scalability both in terms of model size and transformation complexity, and reacting immediately changes in the environment. The engine is uniformly accessible for the different domain-specific transformation languages. As another outcome of the project, such an engine should provide additional support for traceability and debugging for executing parallel and distributed model transformations, which is extremely cumbersome in existing solutions.

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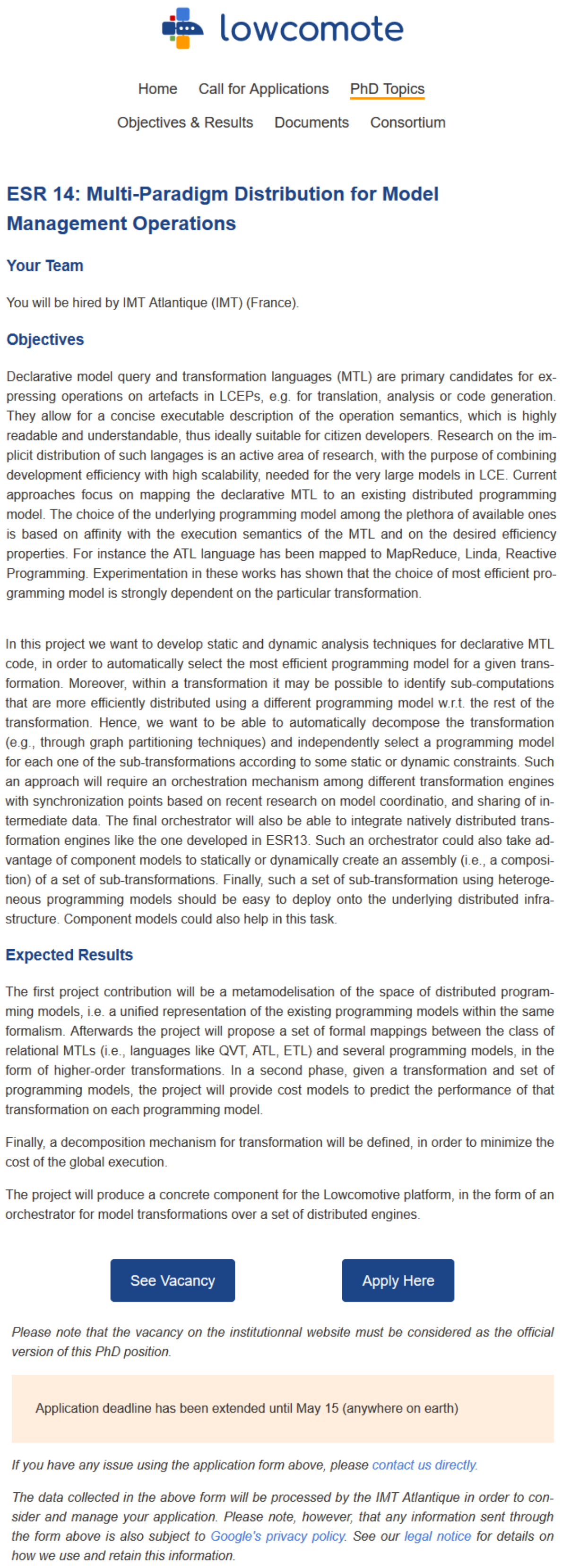
Figure 16 – ESR 13 page



ESR 14: Multi-Paradigm Distribution for Model Management Operations

Your Team

You will be hired by IMT Atlantique (IMT) (France).

Objectives

Declarative model query and transformation languages (MTL) are primary candidates for expressing operations on artefacts in LCEPs, e.g. for translation, analysis or code generation. They allow for a concise executable description of the operation semantics, which is highly readable and understandable, thus ideally suitable for citizen developers. Research on the implicit distribution of such langages is an active area of research, with the purpose of combining development efficiency with high scalability, needed for the very large models in LCE. Current approaches focus on mapping the declarative MTL to an existing distributed programming model. The choice of the underlying programming model among the plethora of available ones is based on affinity with the execution semantics of the MTL and on the desired efficiency properties. For instance the ATL language has been mapped to MapReduce, Linda, Reactive Programming. Experimentation in these works has shown that the choice of most efficient programming model is strongly dependent on the particular transformation.

In this project we want to develop static and dynamic analysis techniques for declarative MTL code, in order to automatically select the most efficient programming model for a given transformation. Moreover, within a transformation it may be possible to identify sub-computations that are more efficiently distributed using a different programming model w.r.t. the rest of the transformation. Hence, we want to be able to automatically decompose the transformation (e.g., through graph partitioning techniques) and independently select a programming model for each one of the sub-transformations according to some static or dynamic constraints. Such an approach will require an orchestration mechanism among different transformation engines with synchronization points based on recent research on model coordinatio, and sharing of intermediate data. The final orchestrator will also be able to integrate natively distributed transformation engines like the one developed in ESR13. Such an orchestrator could also take advantage of component models to statically or dynamically create an assembly (i.e., a composition) of a set of sub-transformations. Finally, such a set of sub-transformation using heterogeneous programming models should be easy to deploy onto the underlying distributed infrastructure. Component models could also help in this task.

Expected Results

The first project contribution will be a metamodelisation of the space of distributed programming models, i.e. a unified representation of the existing programming models within the same formalism. Afterwards the project will propose a set of formal mappings between the class of relational MTLs (i.e., languages like QVT, ATL, ETL) and several programming models, in the form of higher-order transformations. In a second phase, given a transformation and set of programming models, the project will provide cost models to predict the performance of that transformation on each programming model.

Finally, a decomposition mechanism for transformation will be defined, in order to minimize the cost of the global execution.

The project will produce a concrete component for the Lowcomotive platform, in the form of an orchestrator for model transformations over a set of distributed engines.

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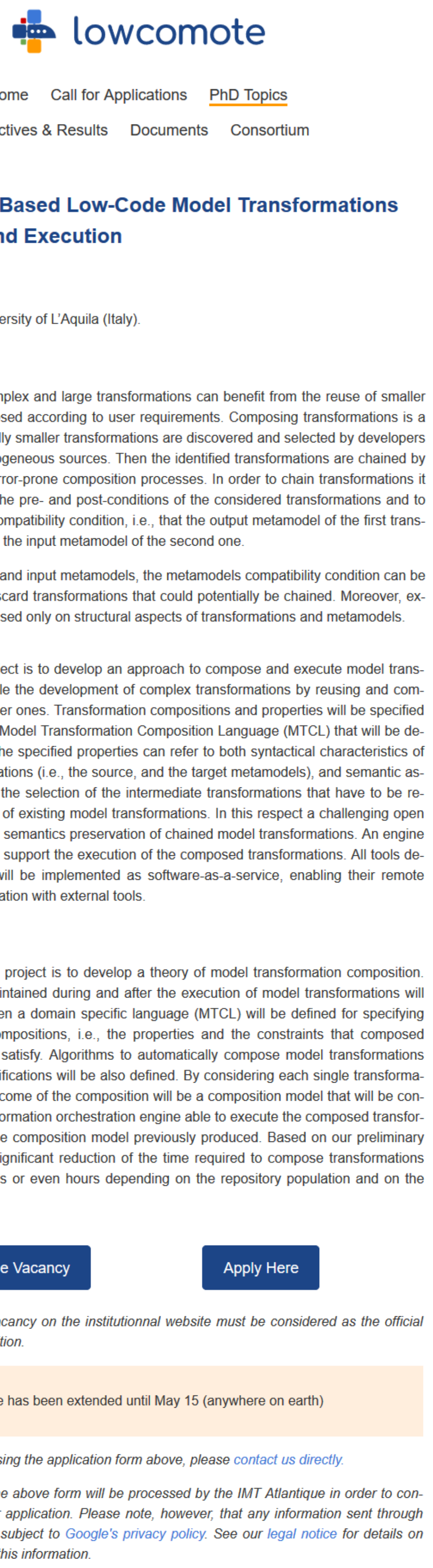
Figure 17 – ESR 14 page



ESR 15: Cloud-Based Low-Code Model Transformations Composition and Execution

Your Team

You will be hired by University of L'Aquila (Italy).

Objectives

The development of complex and large transformations can benefit from the reuse of smaller ones that can be composed according to user requirements. Composing transformations is a complex problem: typically smaller transformations are discovered and selected by developers from different and heterogeneous sources. Then the identified transformations are chained by means of manual and error-prone composition processes. In order to chain transformations it is necessary to ensure the pre- and post-conditions of the considered transformations and to verify the metamodels compatibility condition, i.e., that the output metamodel of the first transformation is immersed in the input metamodel of the second one.

In case of similar output and input metamodels, the metamodels compatibility condition can be too strong and would discard transformations that could potentially be chained. Moreover, existing approaches are based only on structural aspects of transformations and metamodels.

The objective of this project is to develop an approach to compose and execute model transformations that will enable the development of complex transformations by reusing and composing simpler and smaller ones. Transformation compositions and properties will be specified by means of a dedicatedModel Transformation Composition Language (MTCL) that will be developed in the project. The specified properties can refer to both syntactical characteristics of the composed transformations (i.e., the source, and the target metamodels), and semantic aspects that that will drive the selection of the intermediate transformations that have to be retrieved from a repository of existing model transformations. In this respect a challenging open problem is assessing the semantics preservation of chained model transformations. An engine will be also developed to support the execution of the composed transformations. All tools developed in this project will be implemented as software-as-a-service, enabling their remote adoption and easy integration with external tools.

Expected Results

The first objective of the project is to develop a theory of model transformation composition. The properties to be maintained during and after the execution of model transformations will be also investigated. Then a domain specific language (MTCL) will be defined for specifying model transformation compositions, i.e., the properties and the constraints that composed transformations have to satisfy. Algorithms to automatically compose model transformations according to MTCL specifications will be also defined. By considering each single transformation as a service, the outcome of the composition will be a composition model that will be consumed by a model transformation orchestration engine able to execute the composed transformation as specified in the composition model previously produced. Based on our preliminary results in we expect a significant reduction of the time required to compose transformations (from minutes to seconds or even hours depending on the repository population and on the complexity of the chain).

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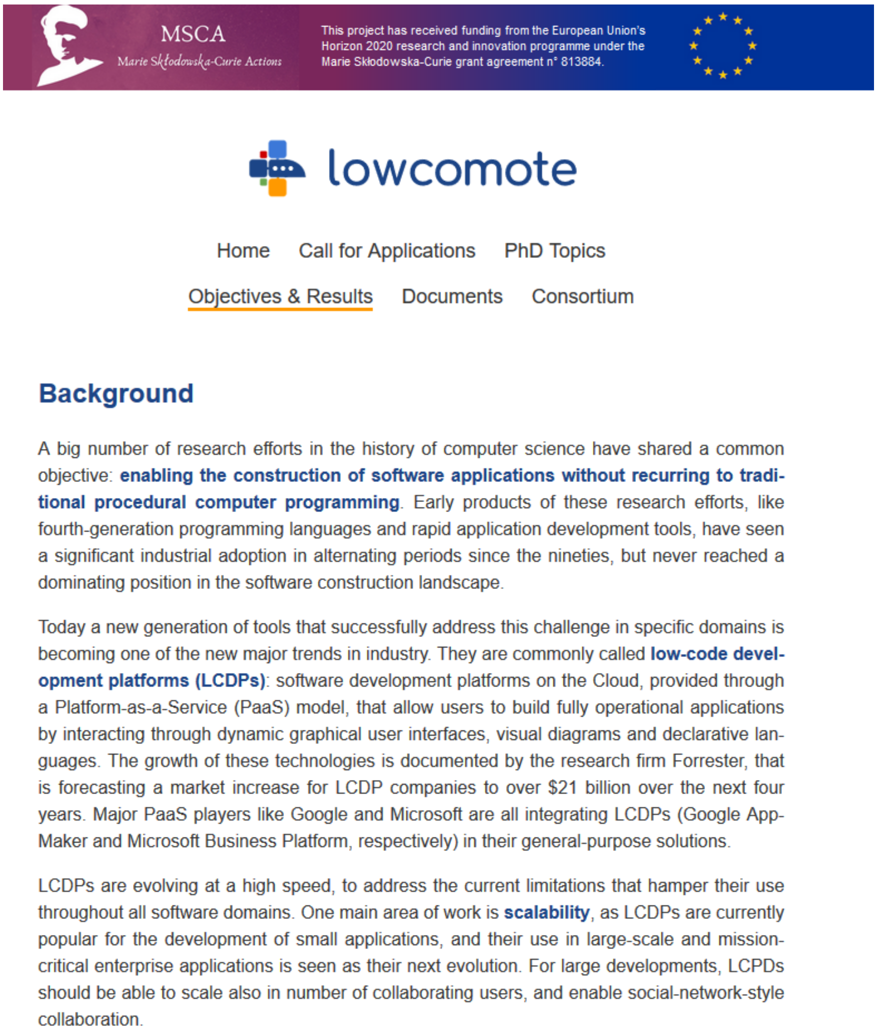
Figure 18 – ESR 15 page

2.4. Objectives and results

It elaborates on the background, main objectives and the expected results of the project. Therefore, it details the workpackage structure of the project. This page can be used as the project abstract to provide the visitors with all the key project information.



This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement n° 813884.

Background

A big number of research efforts in the history of computer science have shared a common objective: **enabling the construction of software applications without recurring to traditional procedural computer programming**. Early products of these research efforts, like fourth-generation programming languages and rapid application development tools, have seen a significant industrial adoption in alternating periods since the nineties, but never reached a dominating position in the software construction landscape.

Today a new generation of tools that successfully address this challenge in specific domains is becoming one of the new major trends in industry. They are commonly called **low-code development platforms (LCDPs)**: software development platforms on the Cloud, provided through a Platform-as-a-Service (PaaS) model, that allow users to build fully operational applications by interacting through dynamic graphical user interfaces, visual diagrams and declarative languages. The growth of these technologies is documented by the research firm Forrester, that is forecasting a market increase for LCDP companies to over $21 billion over the next four years. Major PaaS players like Google and Microsoft are all integrating LCDPs (Google AppMaker and Microsoft Business Platform, respectively) in their general-purpose solutions.

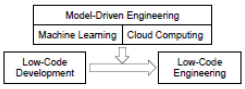
LCDPs are evolving at a high speed, to address the current limitations that hamper their use throughout all software domains. One main area of work is **scalability**, as LCDPs are currently popular for the development of small applications, and their use in large-scale and mission-critical enterprise applications is seen as their next evolution. For large developments, LCPDs should be able to scale also in number of collaborating users, and enable social-network-style collaboration.

Another major problem is **fragmentation**. Each tool vendor proposes his own low-code development paradigm, associated with a particular programming model. Development artefacts cannot be easily migrated to different LCDPs, causing phenomena of vendor lock-up. Moreover no facility is provided for cross-LCDP development, since the interaction among different LCDPs is generally done at the level of generated executable code. Finally it is not possible to easily reuse pre-low-code artefacts, e.g. programs in declarative languages built on traditional development environments. Integrating existing languages in a LCDP requires re-implementing them from scratch, and this is often economically unreasonable for complex languages.

Finally, current LCDPs are limited to the definition of **software-only** systems. This is a particularly constraining limitation for the growth of LCDPs, since while citizen developers have little knowledge of programming, they are often experts in some other engineering domain. These domain experts expect to be able to use their knowledge in the application, at the right level of abstraction and using familiar formalisms. However, no support is currently given for integrating with heterogeneous (e.g. coming from mechanical, electrical, civil engineering) models. This need starts to be observable in the market, as some IoT applications would already benefit from integrating with physical engineering models. Since these models can be very large, poor scalability of low-code methods and tools is again a limiting factor.

Objectives

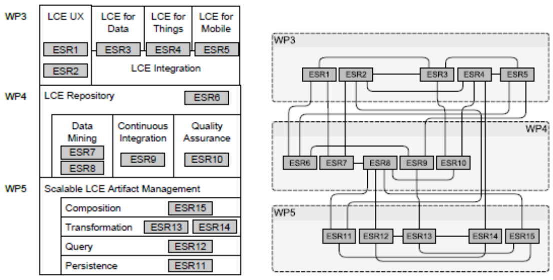
Lowcomote aims to train a generation of professionals in the design, development and operation of new LCDPs, that overcome the limitations above, by being scalable (i.e., supporting the development of large-scale applications, and using artefacts coming from a large number of users), **open** (i.e., based on interoperable and exchangeable programming models and standards), and **heterogeneous** (i.e., able to integrate with models coming from different engineering disciplines). These scientists will drive the upgrade of the current landscape of **Low-Code Development Platforms to Low-Code Engineering Platforms (LCEPs)**.



Lowcomote in a nutshell

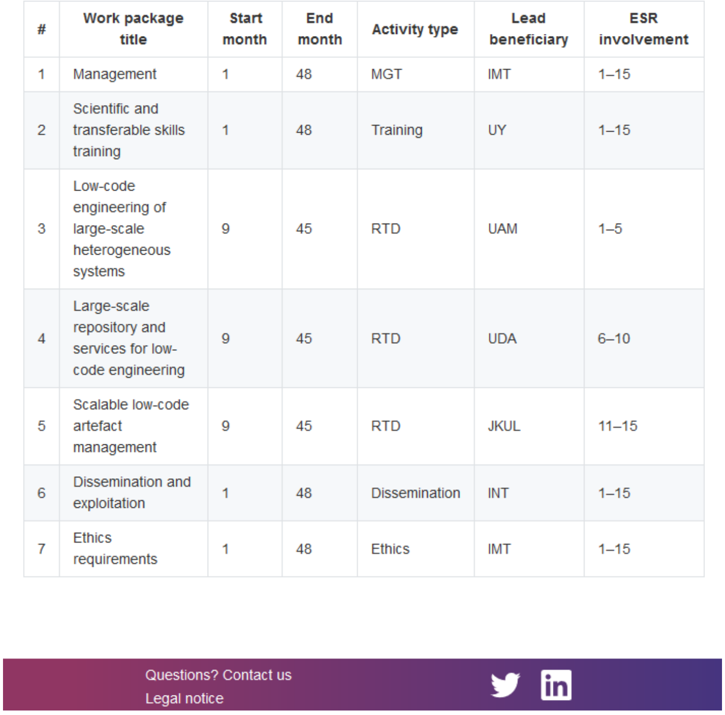
To reach its main scientific goal, Lowcomote integrates an interdisciplinary and intersectoral research program around three specific research objectives (RO). Lowcomote will train ESRs

- **RO1: Enabling Low-code Engineering of Large-Scale Heterogeneous Systems**, by smart development environments on the Cloud and precise integration of low-code languages with new domains.
- **RO2: Developing a Large-scale Repository and Services for Low-Code Engineering**, as a Cloud-based service able to handle a very large number of low-code artefacts, and automatically learn from them.
- **RO3: Producing advancements in Scalable Low-Code Artefact Management**, as new algorithms and reusable components.



Lowcomote workpackage architecture (left) and collaboration through secondments (right).

Lowcomote will explore the required research breakthroughs in three complementary and interconnected research driven work packages, one training-oriented work package, a work-package dedicated to project management and a work-package responsible for the dissemination and exploitation of the findings of the network.

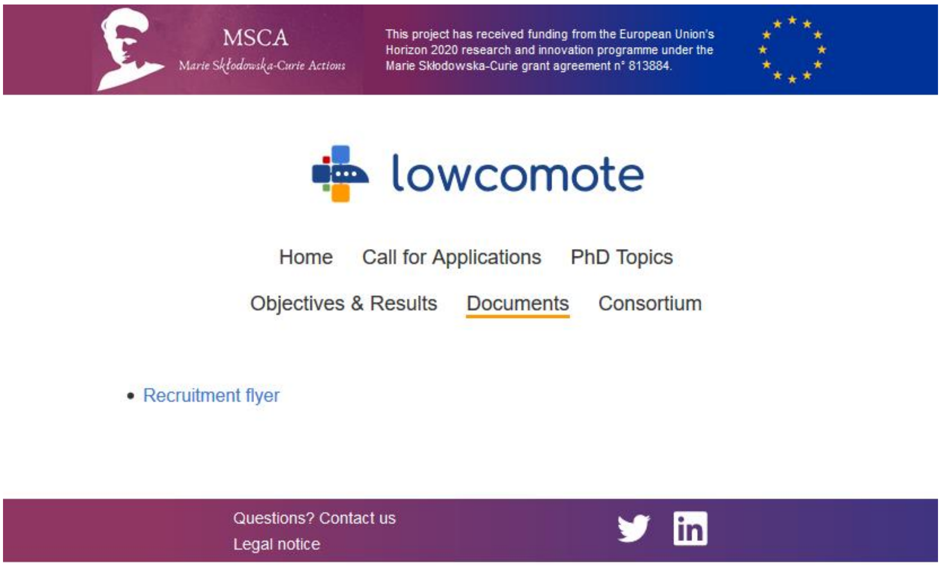


#	Work package title	Start month	End month	Activity type	Lead beneficiary	ESR involvement
1	Management	1	48	MGT	IMT	1–15
2	Scientific and transferable skills training	1	48	Training	UY	1–15
3	Low-code engineering of large-scale heterogeneous systems	9	45	RTD	UAM	1–5
4	Large-scale repository and services for low-code engineering	9	45	RTD	UDA	6–10
5	Scalable low-code artefact management	9	45	RTD	JKUL	11–15
6	Dissemination and exploitation	1	48	Dissemination	INT	1–15
7	Ethics requirements	1	48	Ethics	IMT	1–15

Figure 19 – Objectives and results page

2.5. Documents

This section will contain all project-related documents (flyers, deliverables, articles, etc.)



This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement n° 813884.

- Recruitment flyer

Figure 20 – Documents page

2.6. Consortium

The page lists all project partners, grouped by beneficiaries and partner organizations with a direct link to their institutional website.

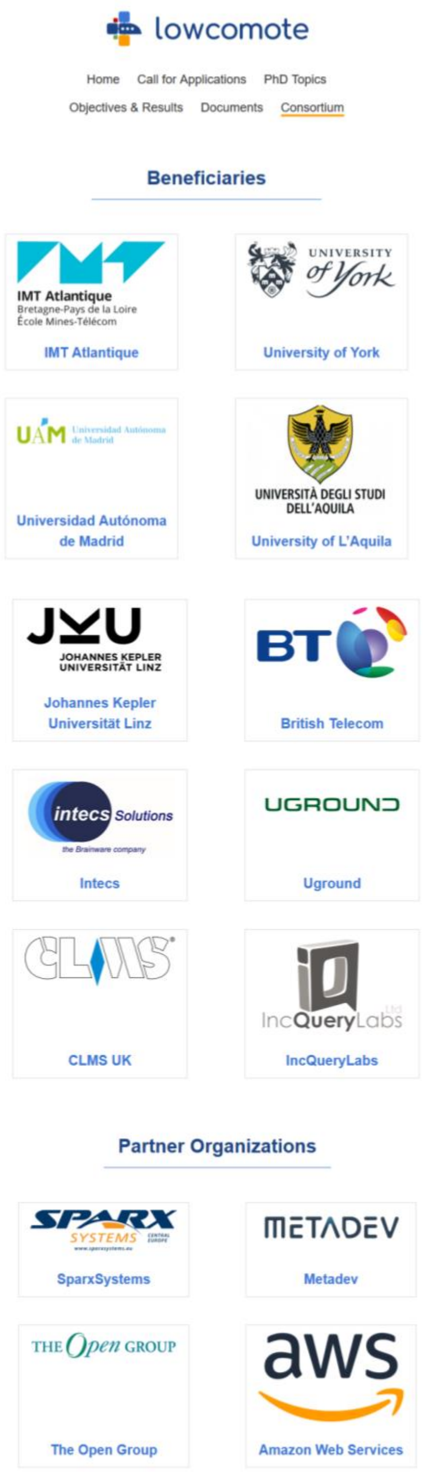
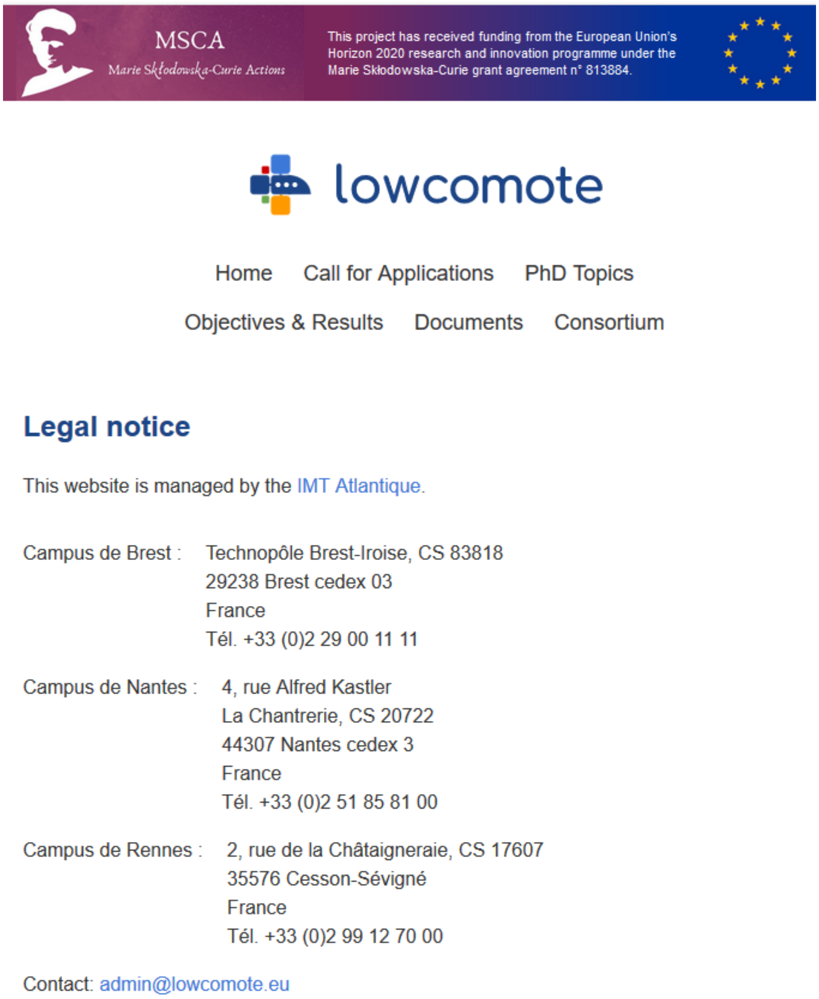


Figure 21 – Documents page

2.7. Legal notice

This page provides basic legal and technical information about the website. In addition, it informs applicants to PhD positions about the use of their personal information sent during application process and their right to access, rectification, deletion and opposition to their personal data by writing to privacy@lowcomote.eu. (redirected to the project's manager e-mail address).



This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement n° 813884.

Legal notice

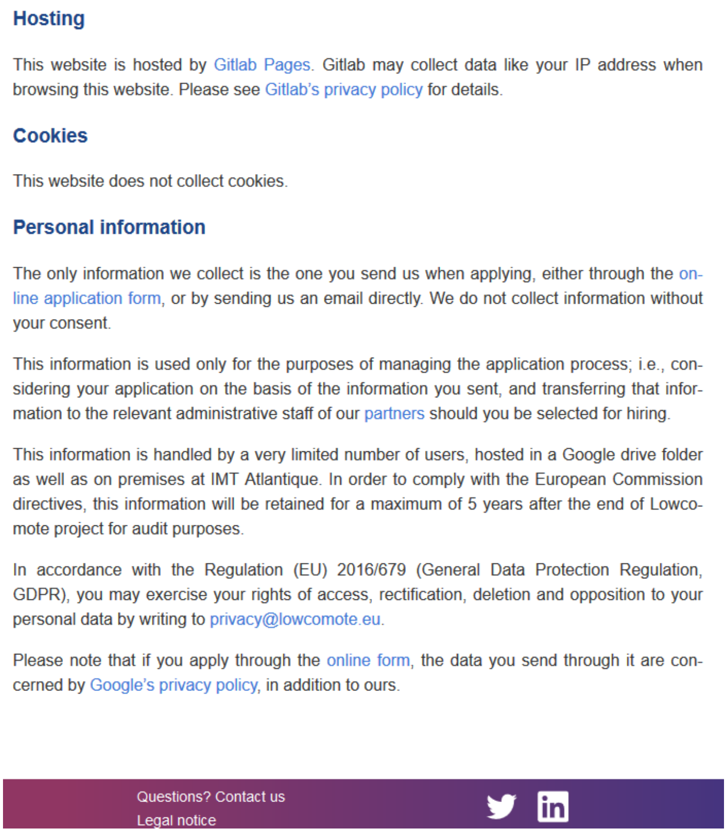
This website is managed by the IMT Atlantique.

Campus de Brest : Technopôle Brest-Iroise, CS 83818
29238 Brest cedex 03
France
Tél. +33 (0)2 29 00 11 11

Campus de Nantes : 4, rue Alfred Kastler
La Chantrerie, CS 20722
44307 Nantes cedex 3
France
Tél. +33 (0)2 51 85 81 00

Campus de Rennes : 2, rue de la Châtaigneraie, CS 17607
35576 Cesson-Sévigné
France
Tél. +33 (0)2 99 12 70 00

Contact: admin@lowcomote.eu



Hosting

This website is hosted by Gitlab Pages. Gitlab may collect data like your IP address when browsing this website. Please see Gitlab's privacy policy for details.

Cookies

This website does not collect cookies.

Personal information

The only information we collect is the one you send us when applying, either through the online application form, or by sending us an email directly. We do not collect information without your consent.

This information is used only for the purposes of managing the application process; i.e., considering your application on the basis of the information you sent, and transferring that information to the relevant administrative staff of our partners should you be selected for hiring.

This information is handled by a very limited number of users, hosted in a Google drive folder as well as on premises at IMT Atlantique. In order to comply with the European Commission directives, this information will be retained for a maximum of 5 years after the end of Lowcomote project for audit purposes.

In accordance with the Regulation (EU) 2016/679 (General Data Protection Regulation, GDPR), you may exercise your rights of access, rectification, deletion and opposition to your personal data by writing to privacy@lowcomote.eu.

Please note that if you apply through the online form, the data you send through it are concerned by Google's privacy policy, in addition to ours.

Figure 22 – Legal notice page

2.8. Contacts

By clicking on **contact**, Internet users may contact the Project Manager.

3. Technical information

The website is powered by Jekyll, which turns plain text documents into static websites. Plain text documents (e.g., Markdown) are easy to edit and share, while static websites have the advantage of being simple to host and very fast to serve.

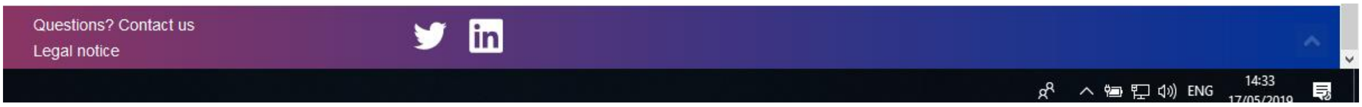
The source content and the resulting website are both hosted by Gitlab.com as part of their free plan. All partners can edit the website, but IMT has been the main drive behind the design and content creation so far.

4. Social media presence

At the time of drafting of the deliverable, two social media accounts have been created both for the recruitment strategy and future communication about Lowcomote:

- A Twitter account has been created: @lowcomote
- A page on LinkedIn has been created: https://www.linkedin.com/groups/13683688/

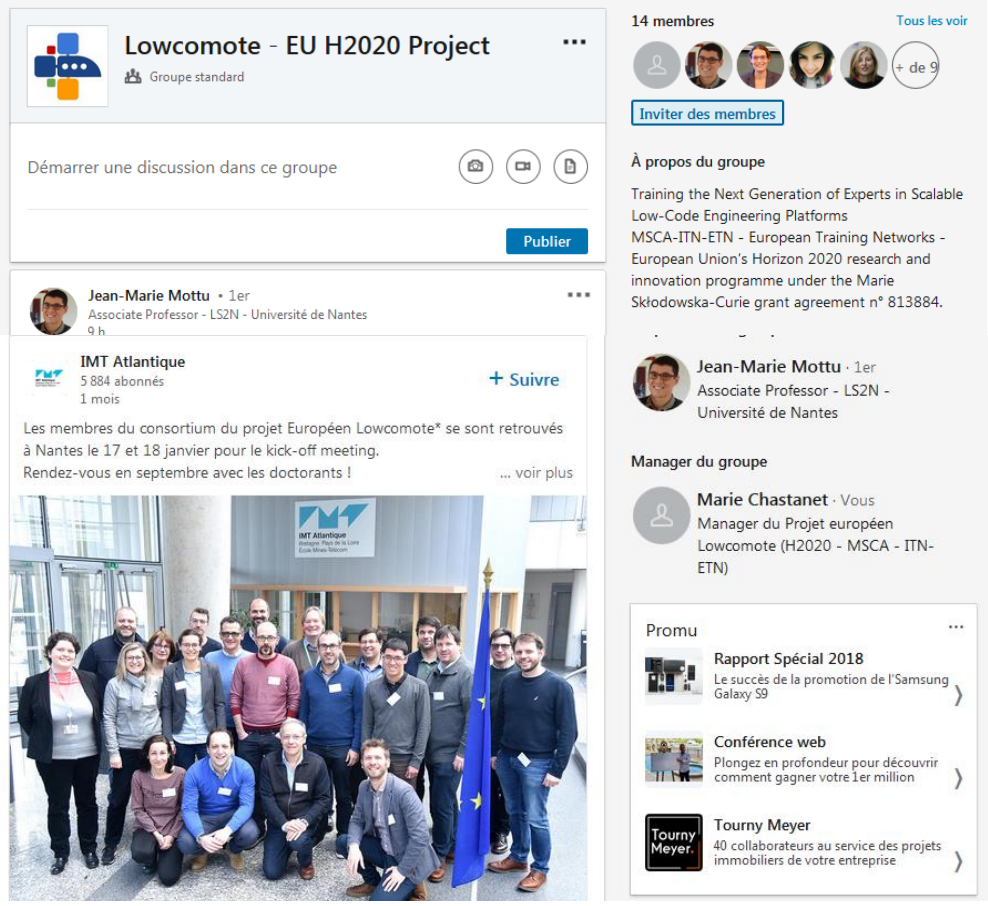
NB: In coherence with its communication strategy, Lowcomote consortium will resort to any additional adapted social media to reach its target audiences.



Questions? Contact us

Legal notice

Figure 23 – Access buttons to social medias accounts



Lowcomote - EU H2020 Project

Groupe standard

Démarrer une discussion dans ce groupe

Publier

Jean-Marie Mottu • 1er
Associate Professor - LS2N - Université de Nantes
9 h

IMT Atlantique
5 884 abonnés
1 mois

+ Suivre

Les membres du consortium du projet Européen Lowcomote* se sont retrouvés à Nantes le 17 et 18 janvier pour le kick-off meeting.
Rendez-vous en septembre avec les doctorants ! ... voir plus

14 membres

Tous les voir

+ de 9

Inviter des membres

À propos du groupe

Training the Next Generation of Experts in Scalable Low-Code Engineering Platforms
MSCA-ITN-ETN - European Training Networks - European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement n° 813884.

Jean-Marie Mottu · 1er
Associate Professor - LS2N - Université de Nantes

Manager du groupe

Marie Chastanet · Vous
Manager du Projet européen Lowcomote (H2020 - MSCA - ITN-ETN)

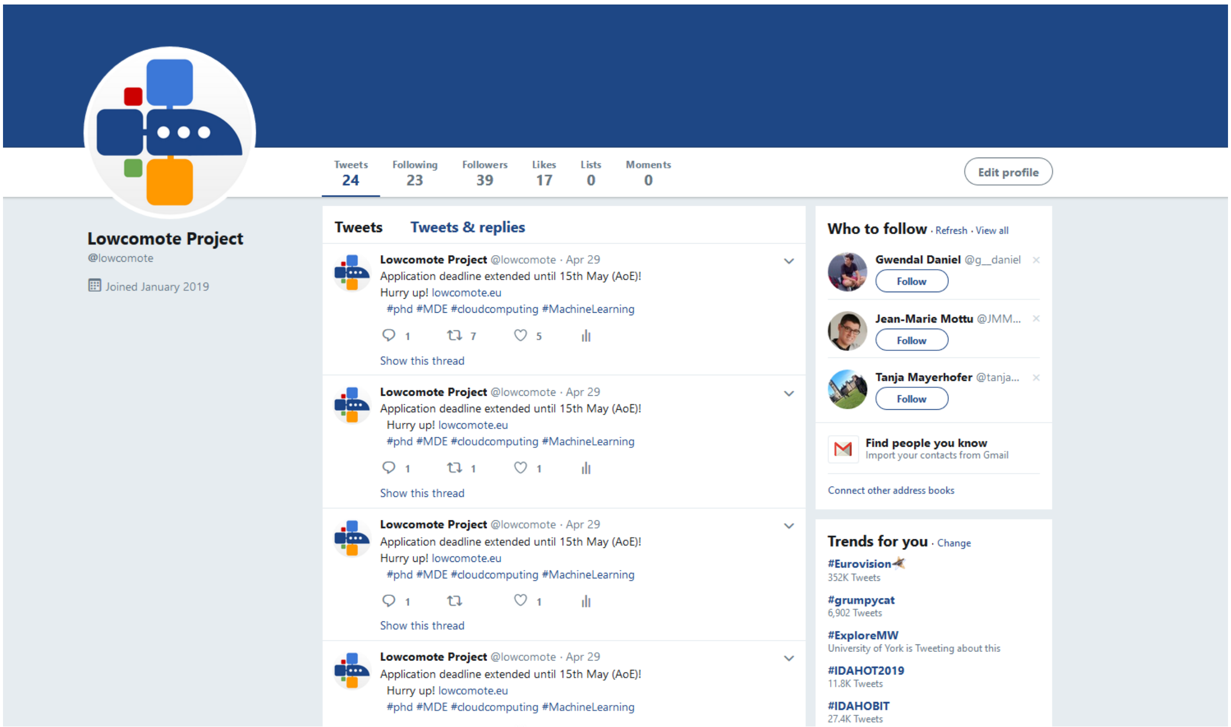
Promu

Rapport Spécial 2018
Le succès de la promotion de l'Samsung Galaxy S9

Conférence web
Plongez en profondeur pour découvrir comment gagner votre 1er million

Tourny Meyer
40 collaborateurs au service des projets immobiliers de votre entreprise

Figure 24 – Lowcomote Group on LinkedIn



Lowcomote Project
@lowcomote
Joined January 2019

Lowcomote Project @lowcomote · Apr 29
Application deadline extended until 15th May (AoE)!
Hurry up! lowcomote.eu
#phd #MDE #cloudcomputing #MachineLearning
1 7 5
Show this thread

Lowcomote Project @lowcomote · Apr 29
Application deadline extended until 15th May (AoE)!
Hurry up! lowcomote.eu
#phd #MDE #cloudcomputing #MachineLearning
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Show this thread

Lowcomote Project @lowcomote · Apr 29
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Jean-Marie Mottu @JMM...
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Find people you know
Import your contacts from Gmail

Connect other address books

Trends for you · Change

#Eurovision
352K Tweets

#grumpycat
6,902 Tweets

#ExploreMW
University of York is Tweeting about this

#IDAHOT2019
11.8K Tweets

#IDAHOBIT
27.4K Tweets

Figure 25 – Lowcomote Twitter account