IAPP1\100130

Intelligence system to improve the sustainability of oil palm crops through the construction of forecasting maps integrating adaptive vegetation indices from multispectral aerial views

Funding sought	£21,346.00
Project start/end	N/A

1. Applicant, institution and partnership details

Lead Applicant (main partner country university representative) and Co-Applicant (main UK and Industry collaborator representatives) Contact Details

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Please include your institution name in the address line

Please provide contact details of the Lead and Co-Applicants
Please enter details for every applicant involved in this proposal, including the Lead Partner Country university and co-applicants from industry and academia in the UK and Partner Country.

Title	Full Name	Job title	Institution	Email
Prof	Juan Alejandro Pena Palacio	Co-Director	EIA (Lead University)	juan.pena @eia.edu .co
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Please upload the CVs of participating collaborators

Each CV should be a maximum of four pages long and submitted as a pdf.

File name	Date uploaded
CV_Ivan Ochoa.pdf	26/11/2017 18:09:03
CV_Hector Patino.pdf	26/11/2017 18:08:45
CV_Alejandro Pena.pdf	24/11/2017 18:37:53
CV_Mario Gongora.pdf	23/11/2017 21:27:40
CV_Fabio Caraffini.pdf	23/11/2017 21:27:36
CV_Isis Bonet.pdf	23/11/2017 21:27:32

Organisation details
Please upload a document with narrative summary details of the lead university and all partnering institutions. These details should include:
For Partner Country Universities:

- # Years institution has been in in existence
- Engineering courses offered

- # students and staff and # in research group
- Indicators of track record (rankings, awards etc)
- Link to website for engineering faculty

For industry partners

- Nature of business and types of products/ services offered
- Indicator of size (e.g. # employees, turnover etc)
- Nature of R&D (if any occurs)

For UK Universities:

- Name of department, institution
- Indicators of track record (rankings, awards etc)
- Link to website for engineering faculty

Please also mention whether any partner is participating in more than one application.
Descriptions of each organisation should be no more than 200 words.

File name	Date uploaded
UNIPALMA.pdf	27/11/2017 00:19:19
DMU.pdf	24/11/2017 19:48:18
EIA.pdf	24/11/2017 19:48:14

Role, contribution and benefits to industry partner
Provide justification for the choice of industry partner including the strategic importance of this relationship to you and your institution. Specify the exact role of the industry partner in this programme. Provide details of what has been achieved so far through any existing collaboration and what is the overall perceived long term vision for this relationship.
You have up to 350 words to answer this question.

Colombia is considered one of the five largest producers of oil palm in the world with about 500.000 hectares being cultivated. This industry has been an ally to bring social investment and progress to the country, becoming one of the most promising alternatives for replacing illegal crops in the framework of the peace process signed in November of 2016. It is estimated that to ensure the reintegration to civil life of 8.000 guerrilla ex-militants, the country needs to increase its production six fold by 2022 to achieved 3'000.000 hectares cultivated (Manrique H. , 2014). The general costs associated with the production of oil palm using hybrid material in Colombia, indicates

that the 24% is associated with fertilization process, the 14% polinization process and the phytosanitary control represents approximately the 6%. That is how the cost of fertilization for 2014 was £400 per hectare on average, where the 85% of the cost represents the product. According with the aforementioned, the fertilization process has the higher costs, for this reason it is necessary to automate the human process related with the foliar and soil analysis activities to achieved a differentiated treatment of oil palm corps. It is estimated that up to 50% cost reduction could be achieve in the fertilization process by automating this step, which also results in less use of fertilizers and achieving better production (Mosquera et al., 2016), (Peña, 2017). However, this requires the cooperation between Universities and the companies in this sector, where the company Unipalma de los Llanos has achieved high relevance in the development of this crop in Colombia from 1982 as a subsidiary of UNILEVER, which constitutes it as a strategic company to develop and validate in a real environment the intelligent system developed in this project. To help the post-conflict in Colombia, the company is interested in the creation of this intelligent system, initially as a service from the consortium, and in the future as a spin off with the support of the Universities, in this way guaranteeing the cooperation between Universities and the Company in the long run.

Role, contribution and benefits to UK partner
Provide justification for the choice of the UK partner including the strategic importance of this relationship to you and your institution. Specify the exact role of the UK partner in this programme. Provide details of what has been achieved so far through any existing collaboration and what is the overall perceived long term vision for this relationship along with expected benefits to the UK partner and UK in general which will result from the collaboration.
You have up to 350 words to answer this question.

The Centre for Computational Intelligence (CCI) of the De Montfort University (DMU) has been in existence since 1995. Throughout these years it has had a consistent strategy of carrying out strong fundamental and applied research to develop fundamental theoretical and practical solutions to real world problems. Using a variety of computational intelligence paradigms and high quality publications, and extended experience in knowledge transfer and the exploitation of research outcomes, they excel in bringing solutions to industry and in the creation of spin offs. According with the framework of this project, the main goal is to create a novel service to improve the oil palm sustainability in a study zone using new technologies based on Computational Intelligence concepts. This service will allow in the future creation of a spin off company or other business models between EIA University, DMU and UNIPALMA, to extend this type of crop with sustainability criteria with international standards to different zones around the world and specifically in Colombia. In this way the CCI becomes a critical strategic partner in the Computational Intelligence area of expertise, in knowledge transfer by the experience and support of the innovation center of the DMU, and the experience of the CCI academics in commercial exploitation of computational intelligence research. In the medium and long term, and according with the expectations of the Colombian government in the expansion of oil palm to 3'000.000 hectares of oil palm cultivate by 2022, this spin off will generate resources to support the long-term research in the Universities in this knowledge and other

knowledge areas related with the topic covered by the system proposed. This will benefit DMU directly and other UK universities at later stages. This collaboration will boost the research process in the Universities and cooperation between universities and industry in the solution of real problems around the world, supporting further the core mission of DMU and the CCI. The project will be supported by the Engineering PhD program in the Partner University and subsequently will enhance the opportunities and collaboration to support additional PhD student participation from DMU's PhD program.

2. Project details

Project Details:
Project title:

> Intelligence system to improve the sustainability of oil palm crops through the construction of forecasting maps integrating adaptive vegetation indices from multispectral aerial views

Please provide a short abstract/summary of the proposed project:

> The Oil Palm is considered by de Colombian Government as one of the main agricultural products to promote the substitution of illegal crops and for job creation in the farm for the post-conflict (Dangond B., 2015), (Tiempo, 2017). To improve the sustainability of this crop, the RSPO (Roundtable on Sustainable Palm Oil) has stablished principles to reduce the use of pesticides, fertilizers and fires, as well as fair treatment of workers according to local and international labor rights (Oil, 2017). This project aims to development an intelligent system to improve the sustainability of this crop in Colombia, using a novel adaptive vegetation index obtained from multispectral aerial views. This will be integrated into a forecasting map using Computational Intelligence concepts, to achieve international standards that support the development of oil palm crops in Colombia, both at small and medium scale. Based on this, the main goal of the agreement between universities and companies is the creation of a novel service to improve the sustainability of oil palm crops in a study zone based in information systems and technologies in precision agriculture, which can be extended to improve the sustainability of this crop all over the world. In this way, the Unipalma of the Llanos will be the company to validate the model in a real environment, the Center for Computational Intelligence (CCI) located in De Montfort University, will be the partner that provides advice to the implementation of the system and the intelligent system as a service, while the EIA University will execute the operative research activities related to the capture and image processing, the implementation and validation of the intelligence system in a simulated and real environment. Both the De Montfort University and the EIA University will combine their experience to take the system to a commercial model.

Total project cost:

> £43,272.00

Total value sought from the Academy:

> £21,346.00

Please provide keywords relating to the project.

This will help us in identifying suitable reviewers

> Oil Palm, Computational Inteligence, Spatio-Temporal Neural Networks, Sustainability,

UAV's, Multispectral-Images

What is the proposed project start date

Projects must start in February and March 2018

01/03/2018

What is the proposed project end date

Exchanges must end by 31 March 2020.

01/03/2020

Is this a new collaboration *OR* is this is a pre-existing collaboration (for pre-existing collaborations you will be required to provide further details).

Pre-existing

If this is a pre-existing collaboration, please detail the extent of the collaboration and the added value this new project would provide.
Added value includes rejuvenating established links, initiating new projects and broadening the network of collaborators.

Three years ago the Tecnnova Corporation (http://www.tecnnova.org/) hosted an event in Medellin, Colombia, and invited an UK expert to present state of the art trends in computational intelligence (CI) and its applications in industry; this expert was Dr. Mario Góngora from the Centre for Computational Intelligence (CCI), DeMontfort University (DMU). This invitation was funded by the British Embassy with the aim to foster collaboration between industry and Universities in Colombia with DMU to solve real-world problems using CI.
In 2016, a researcher from EIA University (Dr. Alejandro Peña) gained a mobility grant from the mayor of Medellín. That year a first visit took place, in which both academics met in person and the interest by the institutions to collaborate was formalised. In 2017, the EIA researcher was granted funding again for mobility under the travel link program from the British Council and the Newton Fund, to improve the cooperation between British and Colombian Universities in strategic knowledge areas for Colombia, specifically in precision agriculture integrating novel computational technologies. With this support, the EIA achieved the development the first prototype to identify oil palm units using multispectral aerial imagery and produced academic outcomes to target high impact internationally recognised journals.

3. Goals, Objectives, Outcomes and Impact

Goals and Objectives

Please state three main objectives for the exchange.

The main goal of this collaborative project is to create a high value service to improve the oil palm sustainability in existing crops and new crops around the world using adaptive vegetation index based on computational intelligence techniques integrated to forecasting maps as a framework. According with the guidelines that define this call, this service supports the substitution of illegal crops using the oil palm in the framework of the peace processes.

In line with the main goal, the specific objectives are:
- To characterize the parameter and variables, which determines the identification of specific units (individual plants) in crops of oil palm in a study zone from multispectral aerial views.
- To create a novel vegetation index using computational intelligence techniques to identify different diseases and possible treatments in each identified unit.
- To create a virtual agent that from multispectral aerial views, allows automating the current process of inspection by hand to identify units in crops that require treatment or have diseases.
- Validating the model in a real environment with relation to the correct identification of oil palm units that require treatment and relating to the localized use of fertilizer and pesticides.
- Establishing the guidelines to create a commercial service (e.g. direct delivery by the consortium) allowing the long-term cooperation between institutions through the generation of new resources to support the research in this subject.
- Improving the collaboration between universities and industry to create new services and technologies with high benefits in this knowledge area.

Teaching, research and innovation?
Please indicate in the estimated %age split of the project in terms of the activities as they relate to teaching, research and innovation. The total of the three ascribed values should add up to 100%.
(e.g. Teaching 60%, Research 30%, Innovation 10%)

Teaching 10%, Research 60%, Innovation 30%

What is the technical and national context of your collaboration and what makes it unique?
Through the IAPP, the Academy aims to support collaborations which are either technically novel and impactful and/ or which leverage existing knowledge in a novel manner locally to address well articulated economic and social development needs. Please articulate the context within which your initiative is taking place, the challenges, needs and opportunities being met and its relation to the state of the art

technically and/ or locally and nationally. Please also show if/ how the project fits or aligns with government or policy objectives locally.

You have up to 500 words to answer this question.

> In Colombian there are about 6.000 producers of oil palm in 2015 reaching a target of 500.000 hectares cultivated and a production of more than 1.2 million of tons of crude oil (Dangond B., 2015). They have become of critical importance for the national government to bring progress and social investment to regions hijacked by drug trafficking, violence and prostitution. This process began with the Plan Colombia between 1998-2002, enabling many entrepreneurs from the subsectors of palm, cocoa, rubber and fruits who created productive cooperatives with farmers for the substitution of illicit crops. While a hectare of coca, marijuana or poppy generated the farmer monthly income of one million pesos, the cooperative project guaranteed double the monthly income for a period up to 28 years using only 12 hectares. In the framework of the peace process in Colombia, the government needed to encourage the creation of cooperative models to ensure long-term livelihood for around 8.000 reintegrated of guerrilla ex-militants, and the sustainability and long-term profitability of the agribusiness in rural zones in where wealth and jobs are often limited. That is why the oil palm plantations offer social benefits ensuring regular income, because is a perennial crop. Actually, it is estimated that around 140.000 direct and indirect jobs come from of oil palm industry, and it is estimated that by 2022 the production of oil palm will increase to 3'000.000 hectares cultivated, generating around 700.000 direct and indirect jobs for the next of 6 years (Gromko, 2015). For this reason, the oil palm becomes one of the crops to boost the farming industry in Colombia. However, the technology is not developed enough in the country and in general over the world to support this type of crops in a sustainable way, where bio-diversity, ecosystems and habitats have to be supported which translates into agriculture good practices with agroecology focus (Londoño, 2017). In practical terms, the government requires an aggressive investment in agriculture resources, finance and infrastructure improvements, to extend sustainably this crop in Colombia through the reduction of fertilizers and pesticides, as well as certification with international standards, for which the development of emerging technologies such as multispectral aerial view and computational intelligence techniques would be of critical importance (EFE, 2016)

What are the expected outcomes and impacts of the project for your Department, University and the wider engineering community and general public in your country?

The Academy wishes to support collaborations which use this grant as a catalyst to build lasting capabilities and generate wide impact. As such please outline the expected outcomes and impacts that will accrue to your own university and plans for activities you will undertake to maximise the benefits of the programme for the the wider engineering community and general public in your country. These may be other/further collaborations, dissemination activities, internships, student projects, training workshops, public engagement, teaching, routes to exploitation/ commercialisation etc.
You have up to 500 words to answer this question.

The National Council for Economic and Social Policy of Colombia published in 2009 the Conpes 3477, which established a development strategy to ensure the competitiveness of the palm industry in Colombia. By 2016, this document got aligned with government policies for job creation, where palm cultivation in Colombia stands out as one of the most promising for a legal, peaceful and stable alternative occupation in the national territory. Therefore there is a need for the modernization of the production and supply chain using emerging technologies and identifying regions of warm weather in Colombia which show potential for the implementation of this crop (Social, 2002).

Another stakeholder interested in the sustainable development of oil palm cultivation in Latin America is the Roundtable on Sustainable Palm Oil (non-profit organization). This entity has created standards to certify the sustainability of this crop considering aspects such as land that should not suffer the effects if deforestation nor have issues relating to child labor. So far the group has certified 3.4 million hectares, which represents only 20% of the total world crop. For the swift growth aspiration of this crop in Latin America (estimates in 226% between 2014-2015), it is necessary to use emerging technologies such as those considered in this document (Gromko, 2015).

In line with the Model 3 and Model 6 that defines this call, the expected outcomes and impact to be achieved by the project are as follows:

1. Develop capacity of the Partner Country engineering research, creating new services with high benefit to improve the oil palm sustainability using new technologies from ICT's in cooperation with the industry.

2. Engage UK research expertise from CCI in solving real world problems in the knowledge area of precision agriculture to maximize the social impact of the project.

3. Improved links between UK Universities with the partner country university with the goal to integrate the world real problems solution boosting the quality curricula in the PhD program at the EIA University.

4. To Support the teaching and research process in the Colombian universities, thanks to the mobility of lecturers and researchers between institutions This will also allow the creation of new programs at undergraduate and postgraduate level in knowledge areas that involve this collaboration.

5. To benefit from the experience that the UK University has in innovation processes, which will be an important input to promote the innovation in the city of Medellín and the participating Universities.

6. To support the technological transformation that is urgently required by the Colombian farmers in line with the requirements that will demand the signing of peace agreements between National Government and the Guerrilla Groups. In this sense, there is an interest of different governments like the UK government to participate in these processes by boosting funding research and innovation.

What metrics for success would you consider suitable for the project? Please give upto 5 specific indicators and targets you hope to achieve with the project to demonstrate success in bullet point form.

Scientific articles:structure of the virtual agent,methodology used to identify the oil palm units in a study zone using multispectral aerial views. Structure of the intelligent system,methodology used to construct the model. Validating the model in a real

environment(sustainability criteria) and evaluating the capacity of the model to inspect a crop in a study zone. Document:long-term cooperation University-Industry and guidelines to create spin-off company between institutions. Document: the benefits of the system in the conservation and incorporation of new crops with sustainability criteria. Dynamical forecasting map to monitor around 100hectares in a study zone.Methodology to Upscale the model at commercial level.

How will the collaboration continue following the exchange and how will the outcomes be built upon?

Provide details on how you will sustain the outcomes of the project, e.g. how you will maintain collaboration. Please also provide information about how this will be funded.
You have up to 300 words to answer this question.

To continue with the collaboration, the EIA University (Lead University Partner) has established three stages:
Stage 1: A first viable minimum service will be obtained as a result of the development of the project with the Support of RAE – Newton Fund and the participating partners. The relevant results include a service as a research product before reaching the final user (One Year).
Stage 2: The intelligent system will be configured for the end user as a viable prototype. Marketing will commence at this stage, for the commercial service and the outlines to deliver the product as a service from the consortium, and eventually create a spin off company that enables to integrate the service development into a ready to use product (One Year).
Stage 3: After the results obtained, the next step is to create a spin off company that will integrate the final user ready system. The partners that will make up the spin-off company will be the EIA University, De Montfort University and UNIPALMA de los Llanos using new international resources destined for this. This guarantees the relationships between partners, and the generation of financial resources to create new services to extend the sustainability to other crops (Five Years).
The cooperation will have a duration in an initial phase (Stage 1 and Stage 2) around of two years under the framework of Industry Academia Partnership Programme 17/18, and a minimum five years supported by the participating institutions in the implementation of a spin off company after the end of RAE support. Is important to note the interest of the Colombian government in the creation of new companies to guarantee the generation of financial resources to support the program to substitute illegal crops.

4. Project planning and resourcing

Provide a detailed description of the activities to be undertaken
Describe the programme of work to be undertaken during the project including how novel, realistic/ambitious the project is. Outline the specific deliverables anticipated and appropriate milestones by which to measure progress. Your description should include:

- Description of the agreed work programme(s) against the objectives, including a breakdown of tasks with which team member will lead and in which country they are to take place
- a detailed technical case for the programme of work
- Outline of the planned stages

There is an option to upload any supporting documents, figures and diagrams in the next question.
Please note: All responsibility for arranging travel and accommodation will lie with researchers and institutions involved, not with the Academy.
You have upto 1000 words to answer this question

According with the objectives, the activities to be undertaken are grouped as following: 1. Stage 1: Create a virtual agent to identify oil palm units. In this stage will characterize the human activities carried out in an oil palm plantation related with the georeferencing, sowing, growing, polinization process, treatment of diseases, fertilization and harvest of fruit. In line with the performance of a Drone (Phantom 3 - Professional) with multispectral camera (Sequoia Parrot) available in the EIA University, a series of critical routes will be created in a similar manner to how a person would navigate a crop. A suitable software based computational intelligence model will be optimized to identify unit oil palms in the crop in a study zone from multispectral images and from the characterization activities. The integration of the characterization of critical routes and the adaptive model in a single structure, will allow to create a virtual agent to characterize not only oil palm crops but to recognize individual units, thanks the adaption capabilities of a learning model. This stage will be carried out in the Unipalma Company in the Cumaral City in Colombia. The company and the EIA University Researchers will carry out this stage. The products obtained in this stage will be reported in a scientific article related with the structure of the virtual agent, and a document related with the methodology used to identify the oil palm units in a study zone. 2. Stage 2: Create an Intelligent System to characterize of oil palm unit crops from multispectral aerial views. After the creation of the virtual agent, in this stage the team will proceed to create an adaptive novel vegetation index based on the computational intelligence concepts. Unlike current vegetation indices, this models will be based in a spatial-multidimensional neural model which integrates the characterization process of both growth and diseases identification taking a reference framework and an adaptive forecast map with the goal to forecast the production in a study zone along time. The most important characteristic in this model is the accuracy of the identification process carried out by the intelligent agent to pinpoint the center of units in crops. As in the previous stage, the capacity both for adaption and learning allows the model to be extended to other types of crops. In this stage will be carried

out by the EIA University researchers and De Montfort University Researchers. The products obtained in this stage will be reported in a scientific article about the structure of the intelligent system used to characterize oil palm units and in a document with the methodology used to construct the model. 3. Stage 3: Validate the Intelligent System. At this stage, a new and extensive literature review will be carried out with the goal to identify the main criteria used to evaluate the sustainability in oil palm crops and other related crops. These criteria will be used to evaluate the model in terms of the success achieved in identifying number of oil palms to fertilize, treat and fumigate correctly, and what are the savings in the use of pesticides, fertilizer, and human health and safety burden in field inspection. At this stage the EIA University and DeMontfort University will carry out the virtual validation of the model, and Unipalma will carry out the validation of the model on the field. The products obtained as a result of this stage will be reported in a document with the results obtained by the validation of the model in a real environment using sustainability criteria and what is the capacity of the model to inspect a crop in a study zone. 4. Stage 4: Create a service with high impact to beneficiaries. After the validation of the Intelligent System, a cost evaluation methodology will be established. The aim will be to evaluate the financial implications of using the system in the field, for real world operations, and assess the business case to support the substitution of illegal crops or the implementation of new crops at a small and medium scale with sustainability criteria. This evaluation will feed the way in which to deploy a service to generate social benefits in farming communities in Colombia, and to create new jobs as a result of the implantation of new crops of this type. This stage will require the involvement of the EIA University and De Montfort University researches and the experts form the Unipalma. This service and the economic returns produced will support the long-term cooperation between university and industry dedicated to precision agriculture in Colombia. As stated before, this service will result in the creation of a company between the parties participating in the project. An additional outcome at this stage will be the signing of an agreement to support the long-term cooperation between the Universities and the Company, and an IP agreement to underpin the creation a spin off company. This agreement will include as well extensive documentation eliciting the benefits of the system in the conservation and implantation of new crops with strong sustainability principles.

Images and diagrams
Upload any images and/or diagrams related to your project. Upload a single document with the images and diagrams in the order you would like them viewed. They should be appropriately referenced in your previous answer.

You can upload a maximum of one file, so if you have multiple images to display then please collate them into a single file, and be sure to arrange them in the order you would like them viewed. A pdf would be the most user-friendly format.

File name	Date uploaded
References.pdf	24/11/2017 14:10:54

Gantt Chart/ Activity Plan

Please upload a detailed Gantt Chart outlining your agreed work programme, including a breakdown of milestones, indicators and target dates for specific elements of the work and the cost breakdown associated with each stage.

File name	Date uploaded
GanttChart.pdf	24/11/2017 18:44:03

Breakdown of funding request
Please use this budget template for submitting your budget:
 IAPP_Sample_Application_budget_template.xlsx. Please outline the total costs of your work programme and clearly show the support you are requesting from the Academy and the contribution your partnership will offer.
The funding shall be awarded to a single partnering Institution. The Recipients of grant funding will be expected to provide all parties with resources to enable the programme of activities to take place. Partners within applications should make such financial arrangements before the application is submitted, and evidence of such will be required at the contractual stage.
Funding guidelines:
 The total contribution from the Academy must be up to GBP 50,000. This amount must be at least 50% matched by the applying institutions from their own or leveraged resources.

- This programme offers **financial support for (economy class) travel, subsistence and salary support costs** related to your proposed activities amongst industry and academic partners in Partner Countries and the UK.

- There is no set limit on how much you can claim in any one category apart from consumables and other costs, where no more than 10% of the total cost may be requested. 'Consumables' include project specific costs of small equipment, computer software licenses or publication costs. Examples of 'other costs' are conferences and seminar fees.

- Please note that the funding provided by this scheme is *not* calculated on the basis of full economic costs.

- Successful applicants will receive 70% of the total award value at the project's start, after contract signature and the remaining 30% at the project's end, upon receipt of a satisfactory final report.

- Additional costs on top of the grant funding must be met by the participating Institutions or leveraged from elsewhere with clear indication with respect to the source of the matched contribution.

- The funding provided cannot be used to pay for purchases of large equipment and research infrastructure.

File name	Date uploaded
Budget.xlsx	24/11/2017 19:47:20

Justification of costs
Please provide a brief explanation of all costs, covering both what the funds will be spent on and why. We require evidence that you have researched the costs for which you are seeking support; for example you could include the cost per night of accommodation. Travel costs should be based on the most suitable and economical form of travel. Subsistence costs should reflect the normal rates applied at the host institution/s.
Please Note: This programme offers support for travel, subsistence and salary support costs related to conducting collaborative activities amongst industry and academic partners in the Partner Country and the UK.
You have up to 300 words to answer this question.

The costs defined for the project were calculated taking in account the following: Subsistence, accommodation, regional transport and expenses – DeMonfort Researchers: £170 per Day. 4.2.1.1.1.4 Flight (inc. transfer) leicester-birmingham-madrid-medellin-madrid-birmingham-leicester: £1250 each. 4.2.1.1.1.5 Fligth Medellín-Villavicencio-Medellín: £128 each. The cost estimation was done considering a stay of the researchers in Medellín for a period of seven (7) days. Is important to highlight that the researchers will have to fly to Villavicencio with the goal to adjust the intelligent system in a real environment. The estimation of the regional transport was done taking as base Medellin and Villavicencio City in Colombia, and taking a total of sixteen trips (16), one for each period that the De Montfort Researchers stay in Colombia, and eight (8) trips by Colombian researchers. The salaries of the Colombian researchers are part of the contribution of the EIA University and the UNIPALMA de los Llanos Company; the time of the UK researchers is provided by their University. For the three of the five trips to the UK the expenses to for the Colombian researchers are funded by the Royal Academy of Engineering. The costs associated with Software, Infrastructure and Technologies are assumed by the Universities. In the case of the Company, this cost is built in their budget. The UpScaling and setting the business model is assumed by the partners.

Additional Funding Details
Please provide details of any additional funding which will be provided by the partnering organisations or others in support of the project. The Academy requires that at least 50% of the funds being asked for be matched in contribution by applicants. Additional funding above 50% will be viewed positively, being further evidence of the value placed on the collaboration and its potential for impact.
You have up to 300 words to answer this question.

Is important to highlight that at the moment of the call, the costs associated with the actual and future development of the project is drawing from resources associated to a

grant from an internal call in the EIA University. This internal project funded a Drone (Phantom 3 professional) and a Multispectral Camera (Sequoia Parrot). This project has a final date at December 2018. Given its original Framework, the internal project may be extended to match the final date established for this project with new resources that support the Colombian researchers.

Please provide details on the ownership of any pre-existing or future Intellectual Property to be used/ generated and any formal agreements to this effect (input N/A if not applicable)
If the project involves the use or potential generation of Intellectual Property, provide the details of any relevant agreements. If no formal agreement exists or is planned, include considerations on any potential risk to IPR and how the risk will be mitigated.
Please note: In projects which aim to generate IP, The Academy expects the researchers and institutions to agree in writing on Intellectual Property Rights (IPR) before the start of the exchange. Any agreement should allow for agreed dissemination activity to be undertaken unhindered. The Academy will not have any claim on research funded by the scheme.
Guidance on reaching Industry Academia IP agreements as well as model arrangements for collaborative research can be found here: https://www.gov.uk /guidance/university-and-business-collaboration-agreements-lambert-toolkit
You have up to 300 words to answer this question.

With respect to the Intelligent System as a service and any other IP created, the institutions will formalise in writing an IPR agreement before the start of the project. The terms will comply with the guidance of the RAE as these will consider both the commercial IP exploitation by the Universities and industry as well as allowing the dissemination of the results both to the Colombian society and the academic international community. This agreement will be signed at the start the project. All previous IP consist of research outcomes and has already be reported (or on the process of review) in academic publications; for this reason is not on the table for an IP agreement as is to be considered already public academic knowledge. The IPR agreement will include as well a defined framework for the creation of a spin off, in which the participation distribution (percentages) will established, according with the business model and the marketing of the technology for worldwide application.

5. Letters of support and declaration

Lead University declaration

The purpose of the declaration is to confirm that the application is acceptable in principle to the Lead Partner Country University, and that it has received all necessary internal authorisations.

The declaration terms must be transferred to headed paper and be signed by an appropriate officer from the Lead applicant's institution/university. A scanned copy of the letter should be uploaded by the applicant. We do not need the hard copy version to be sent through.
The terms that the declaration must contain are shown below. Please copy these bullet points directly into your Institution's declaration.

- The applicant will be employed by the institution/university for the duration of the award.
- The applicant and any co-applicant(s) will be given full access to the facilities, equipment, personnel and funding as required by the application.
- The costs submitted in the application are correct and sufficient to complete the award as envisaged. Any shortfall in funding will be met by the institution/university.
- The institution will ensure that the proposed programme of work has been agreed between all institutions involved in the exchange and that all necessary contracts, visas, IPR agreements, financial processes and other necessary arrangements are in place before the start of the exchange.
- The institution is satisfied that language will not be a barrier in regard to a successful collaboration and, if necessary, sufficient language support and training will be obtained in advance of the exchange visits.

File name	Date uploaded
LetterOfSupport_DMU-CCI.pdf	24/11/2017 20:36:47
LetterOfSupport_EIA.pdf	24/11/2017 20:36:42
EIAs Declaration.pdf	24/11/2017 20:35:47

Applicant declaration

I understand that should this application be successful I will be required to sign a contract based upon the terms and conditions published on the website. I confirm that all the information submitted herein is wholly accurate at the time of submission, and I will update the Academy of any material changes which may affect the project.

I confirm that I have the permission of any person or persons I have included contact details for, to share their details with the Royal Academy of Engineering for the purposes of administering this application.

Furthermore I acknowledge that the Royal Academy of Engineering will disclose the information contained within this application to external parties for the purpose of assessing the application.

Name and position:

Olga Lucia Ocampo Toro. Secretary-General

By ticking this checkbox I agree to be bound by the conditions for this scheme.

6. Marketing

Where did you hear about the scheme?

Please select all of the relevant options. The information provided will help us improve our communication strategy.

From my university 'Grants Support Office'

From a website/social media

If you have selected 'other' above please specify