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28 October 2019

Dear Ata

RE: QR Global Challenges Research Fund 2019/20 Round
"Development of Wireless Sensor Bridging for An Internet Backbone Connection in Rural Areas in Riau Province, Indonesia"

Thank you for providing the requested further information on your application. I am pleased to inform you that your proposal has been approved for funding.

Please note the following conditions of this award:

- ODA compliance is critical and must be maintained.
- Funding is dependent on ethical approval being obtained via CURES prior to the start of the project to ensure research integrity.
- Your project value is as agreed and approved in your B3.1, you will be issued with a project specific job code which you should claim against.
- All spend must occur by the 31 July 2020.
- You must submit a final report to RIO on your project activity, outcomes and impact by 31 August 2020 (a copy of this year's template is attached for information, we will send you an updated form to complete based on the 2020 Research England requirements).
- You may be asked for further reporting updates beyond 31 August 2020 to track project impact and ensure we meet our reporting requirements to Research England.
- If you encounter any issues with delivery or wish to make changes to your project please contact RIO (researchoffice@cranfield.ac.uk) as soon as possible.

Congratulations for being awarded this highly competitive funding.

If you require any further information or assistance please contact the RIO grants team on researchoffice@cranfield.ac.uk

Yours sincerely

Professor Tom Stephenson FREng
Pro-Vice-Chancellor, Research and Innovation

THE QUEEN'S
ANNIVERSARY PRIZES
FOR HIGHER AND FURTHER EDUCATION
2015 & 2017

Global Challenges Research Fund 2019/20 Round

Cranfield Institutional QR Allocation Application Form

Please read the associated guidance document before completing this form.

Proposal Details
Title: Development of Wireless Sensor Bridging for An Internet Backbone Connection in Rural Areas in Riau Province, Indonesia
PI Name: Dr Ata Khalid
Theme/School: Cranfield Defence and Security
Which grant type/types are you applying for: ☒   **Travel and Subsistence (typically up to £10k*)** *(To support: 1-2-1s, networking meeting or workshops; undertake short / small pieces of research; joint publications; joint supervision of PhD students; and access to facilities and laboratories for research and field-based observations.)* ☒   **Research Seed corn funding (typically up to £5k*)** *(To support: proof of concept work, feasibility studies and generation of pilot data.)* ☐   **Impact and translation (typically up to £10k*)** *(To support: generation of impact from completed or existing projects that are ODA and GCRF compliant; new activities that support impact; the monitoring and evaluation of impact in conjunction with academic and research institutions, commercial organisations, government bodies and NGOs.)* ☐   **Capacity and capability (typically up to 5k*)** *(To support: payment of bench fees; provide access to facilities; support distance learning on a case by case basis; develop case studies of GCRF research and impact to facilitate wider learning, best practice and lessons learned; facilitate stakeholder communities of practice; support knowledge exchange activities.)* ***Proposals can request more than one type of grant as part of a package of activity. Requests that exceed the indicative funding limit per grant type will be considered provided that the costs are strongly justified.**
Cranfield staff involved in delivering the proposed activities: *(name, role, grade, centre/dept. of staff/secondee who will deliver the project or activities)* • **Dr Ata Khalid, Principal Investigator, Lecturer in Sensors and Sensor System, Cranfield Defence and Security**
Location: *(please state which (site, department/centre) and facilities (labs) will be used to deliver the project or activities)* • **Centre for Electronic Warfare Information and Cyber, Sensor Group, Cranfield Defence and Security, Martell House, Cranfield University, Cranfield.**

External partners: *(name, location and role of external collaborators within the UK and overseas, this includes research staff, academic collaborators and industrial partners)*

- **Universiti Tun Hussein Onn Malaysia (Faculty of Electrical and Electronic Engineering, EMC Center)- Principle Investigator 1: Dr Ramlee Kamarudin, Co-Investigator 2: Dr Fauziahanim Che Seman**
- **Universitas Islam Riau, Indonesia (Infrastructure and Network, Architecture, Geography, Wireless Communication and Remote sensing laboratory), Co-Investigator 3: Dr Evizal Abdul Kadir.**
- **Telkom Indonesia (Infrastructure and Internet Connection): Project Partner.**
- **Local Authorities (Policy Development, Support, Approval and Permission): Project Facilitation Partner**
- **Local Community (Knowledge Dissemination and Transfer): Mr. S.P Martinus, Project Partner.**
- **Specialist Microwave Solutions Limited, UK: Mr. Nigel Mead, Project Partner**

Existing relationships *(please detail if you have existing links with your proposed partners and the nature of these links e.g. MOU, Studentship programme, collaborative project)*

- **Dr Khalid and Dr. Ramlee Kamarudin written a collaborative research project and submitted to EPSRC in 2018)**
- **Dr. Khalid and Dr Fauziahanim Che Seman are preparing a collaborative Terahertz technology project for an EU2020 project since late 2018. We are also considering student mobility programmes.**
- **Dr Ramlee Kamarudin, Dr Fauziahanim Che Seman and Dr Evizal Abdul Kadir have worked in past for several joint projects funded by Malaysian Government.**

- **Which country/countries on the DAC list of ODA recipient countries will directly benefit from this proposal?**

Indonesia

How is your proposal <u>directly and primarily relevant</u> to the development challenges of this country/these countries?

The Indonesia National Long-Term Development Plan 2005-2025 has outlined the vision to improve people's prosperity through the mastery of science and technology and improvement of information and communication technology (ICT). The main problem in rural areas are lack of electricity, communication, transportation infrastructure and lack of knowledge about new technology compounded with the unique Indonesian landscape challenges. Compared to other countries, the development of ICT in Indonesia ranks 111 in the 2017 ICT Development Index (IDI) ranking, (ITU, "Measuring the information society Report 2017," ITU, 2017). Compared to other developed countries in Southeast Asia, Indonesia is still lagging behind and is only above from Cambodia (128), Myanmar (135) and Timor Leste (122). The toughest challenge for implementing ICT Indonesia is the condition of the territory of Indonesia, which consists of islands, mountains, jungles and various Indonesian cultural factors. One of the challenges set out within the Indonesia National Long-Term Development Plan 2005-2025, is that of the need for Indonesia to increase the utilization of information available via telecommunications and increase availability of the services. This plan sets out to achieve a nation that is more prosperous and affluence having a developed communication infrastructure network that is reliable and integrated. This project will address some aspects of these ICT challenges, which are currently limited, by offering affordable and reliable facilities and infrastructure. We will be able to provide some solutions to have the information access deeper in rural and difficult terrain and with high bandwidth and as a result help reduce the digital gap, among regions in Indonesia as well as between Indonesia and other nations. This proposal responds to the challenges set out in SDG9 by giving more people in rural communities of Indonesia access to reliable internet communications and therefore directly addressing target SDG9.C to significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in the least developed countries by 2020. It will also, indirectly, address SDG4 by improving basic communications infrastructure to provide access to effective learning materials to those who live in rural communities. Related to this, the Indonesian government has proposed its budget for 2020 with £27billion being committed to improve basic education and build infrastructure for education in villages. The long-term benefits of this work will also address the challenges outlined within SDG8 via its effects on improving access to education and therefore reducing the number of young people not in employment, education or training.

How do you expect that the outcome of your proposed activities will promote the economic development and welfare of this country/these countries?

In Indonesia, the latest telecommunication technologies are mainly implemented in the cities where the physical infrastructure exists, but is unavailable to many people in rural areas. The internet connection is an essential and important technology for individuals in the modern world to gain access to education, and to allow businesses to function. The economic activity is an indicator of a community's prosperity and we have seen around the world the increased internet and ICT services has direct affect in uplifting the living standards of the population. People in Indonesian cities are now using internet for marketing, online selling, trading and purchasing things. The rural communities would also have the same opportunity if the internet connection could be made available in their areas, thus benefitting their economic development, education and social welfare by giving them access to the same information, education materials, and business opportunities. This proposal aims to establish internet connectivity to rural villages within Indonesia, which will bring prosperity to their communities and their local areas, therefore, increasing the economic activities in the depth and breadth of the

rural communities. It will also connect rural communities with cities, this will start commerce between the rural areas to cities, and as a result, it will bring long-term economic benefits for Indonesia.

Project or Activities Description

Introduction: In today's world, an internet access is vital and essential to support economic development, education, public administration, communication and many other applications. In Indonesia, an internet connection is supported by cellular networks (i.e: 3G and 4G-LTE) and fiber optic cables [1-2]. However, this service is mainly provided in most of the cities in Indonesia. Due to enormous populations, more than 50% of people are still living in the rural and remote areas. In such areas, the 4G-LTE has worsened or disappeared or even 3G services due to the geographical landscape such as hills, vegetation and islands. Moreover, the fiber optic communication is unlikely to be deployed as it is relatively complex, time consuming and costly. Therefore, many people in these areas depend on the public telephone networks or 2G and 3G services in some specific regions that have better coverage [3]. These limitations can be circumvented with the development of basic infrastructure for an internet backbone connection that could establish connection and link between cities and rural/remote areas [4]. Therefore, in this project a wireless sensor bridging is proposed for long-range point-to-point/multi-point communication. UK-Malaysian team will carry out the design jointly but manufacturing will be jointly by Indonesian-Malaysia team for logistic reasons. It is expected to achieve up to 10 km distance between transmitter and receiver. Current technologies provide for up to 5km (line-of-sight). Once we will achieve the success of initial link connections in the first phase, the UK team will introduce semiconductor based high frequency transmitter/receiver antennae design to push the technology towards 5G bandwidth to enable more commerce and social services that are currently impossible even with 3G networks. Hence, this project directly addresses the Sustainable Development Goal 9: Industry, Innovation and Infrastructure, which can be beneficial for local people, authorities, policy makers and the stakeholders. We will select few rural areas in Riau Province for this project to field test the viability and then roll out for beta-test subscriptions for the local population through educational workshops and word of mouth activities. The design and technology development workshops will take place in Malaysia and Indonesia with UK team representations.

Aim
The aim of the project is the development of wireless sensor bridging that is capable of providing an internet backbone connection in rural or remote areas.

Specific objectives
- To conduct a propagation study to examine the differences in the information of the propagation pattern due to different geographical structures or types.
- Development of new multiple antennas or MIMO antennae for wireless bridging system for long-range (up to 10 km) point to point/multi-point at 5.8GHz.
- Data collection, analysis, investigation, and consideration for high bandwidth 10-30GHz systems.
- Dissemination of the results to the stakeholders and society through workshop, public event and publications

Activities
1. Discussion on the detailed project and hardware design/manufacturing with all parties including the UK PI, Malaysia Co-I, Indonesia Co-I, local researchers, authorities, communities and Telco Company (Telkom Indonesia) followed by technical workshop in Malaysia [1st Nov 2019 – 31st Dec 2019]
2. Identification of the locations (few rural areas in Riau) [1st Jan 2020 – 31st Jan 2020]
3. Obtaining Riau local authority's approval and permission to conduct research [1st Feb 2020 – 28th Feb 2020]
4. Design and propagation study at the designated locations [1st Mar 2020 – 30th Apr 2020]
5. New antennae design for wireless bridging transceiver that have the capability for long-range communications (up to 10km) [1st Mar 2020 – 31st May 2020]
6. Manufacturing of the antennae and Measurement [1st Apr 2020 – 31st May 2020]
7. Wireless network bridging system installation at the designated locations and commencement of new high bandwidth and high frequency antennae designs (10-30GHz) in UK. [1st April 2020 – 30th June 2020]
8. Data collection and analysis and system adjustment in Indonesia. While at the same time lab design test of new 10-30GHz antennae UK [1st May 2020 – 31st July 2020]
9. Knowledge Transfer Workshops in Malaysia and Indonesia and dissemination through publications, public events, workshops and community engagement [1st June 2020 – 31st July 2020]

Milestone 1: Completion of Project Discussion in technical workshop in Malaysia (Dec 2019, by Month 2)
Milestone 2: Completion of propagation study and new antennae design (May 2020, by Month 7)
Milestone 3: Completion of system installation, data collection/analysis/final report (July 2020, by Month 9)

References:
[1] F. Turniski, et.al, "Analysis of 3G and 4G download throughputin pedestrian zones", IEEE 2016 International Symposium ELMAR, Page(s): 9-12, Sept 2016.
[2] P. K. Sharma, et.al, "Optimization of propagation path loss modelin 4G wireless communication systems", IEEE 2018 2nd International Conference on Inventive Systems and Control, Page(s): 1245-1248, June 2018.
[3] C. I. Samuels, et. al, "Service level measurement based on uptime data monitoring for rural internet access in Indonesia", IEEE2017 11th International Conferenceon Telecommunication Systems Services and Applications, Page(s): 1-5, Feb 2018.
[4] D. Sari, et. al, "ICT Development strategy for rural area in West Java", IEEE 2018 International Conference on ICT for Rural Development, Page(s): 112-117, May 2019.

Outcomes, Outputs and Gender Equality Compliance

Deliverables/ Outputs (academic and non-academic): *(briefly describe your anticipated deliverables and outputs from the funding – please see page 1 for details for each scheme type)*

For this project, several key deliverables will be carried out

1st Deliverable: **Propagation and environmental study (Person In-Charge: Dr Evizal Abdul Kadir)**

Output:
- Radio Propagation study and model between transceivers including vegetation effect and rain attenuation
- Few locations will be identified to install the wireless bridging system.

2nd Deliverable: **Development of new antennae design for wireless network bridging transceiver (Person In-Charge: Dr Ata Khalid, Dr Ramlee Kamarudin and Dr Fauziahanim Che Seman)**

Output:
- New network design (Multiple/MIMO)
- Up to 10km distance
- Fabrication and measurements

3rd Deliverable: **Wireless Network Bridging System for an Internet Backbone Connection (Person In-Charge: Dr Ata Khalid, Dr Ramlee Kamarudin and Dr Fauziahanim Che Seman)**

Output:
- Internet access connection in the designated rural areas
- Internet connection between cities and selected rural areas
- High bandwidth and high frequency network feasibility for 10-30GHz system for potential 5G delivery.
- Copyright/Patent

4rd Deliverable: **Knowledge Translation of the research (PI and all Co-Is)**

Output:
- Publication in academic research
- Publication in newspaper/magazine to be easily accessed by public domain
- Workshops and Public events in Malaysia and Indonesia.

Impact to Support Cranfield's GCRF Strategic Aims: *(briefly describe the anticipated impacts from the funding – please see the guidance document for details of the GCRF strategic priorities)*

This project addresses directly the Sustainable Development Goal 9: Industry, Innovation and Infrastructure which can be beneficial for local people, authorities, policy makers and the stakeholders. The technology developed in this project will be beneficial and has a direct impact particularly on the public services such as schools and hospitals for better education and management, respectively. Universitas Islam Riau has existing links with the local government which will be able to provide support and permission to conduct this research. The support and engagement from the local telco company such as Telkom Indonesia are also recommended particularly in providing communication infrastructure in rural areas. Whilst, Universiti Tun Hussein Onn Malaysia, through EMC Center, has facilities to develop, fabricate and measure the system. The electromagnetic emitted by the system could also be measured to ensure the level of electromagnetic radiation is acceptable for such environment.

In addition to developing wireless sensor bridging system, Cranfield University with these two universities will benefit from new international collaboration and building new expertise that could see future projects to be fashioned, collaborated. Furthermore, it is foreseen that this project will lead to publication and knowledge transfer especially to local authorities and communities in order to provide them with better knowledge and services. This project will become a pilot project and later it will be extended to other rural and remote areas in Indonesia, Malaysia and other Southeast Asia countries. The involvement of Specialist Microwave Solutions Limited UK will be a strategic partnership that would ensure a rapid development of a new technology solutions that will open up several avenues of entrepreneurial ventures not only in the target countries but it has potential to build some niche products at low cost for data poor communities around the world.

Gender Equality Statement: *(Research funded through this call must comply with the International Development (Gender Equality) Act 2014. Further guidance on the meaning and interpretation of Gender Equality can be found in the Guidance document. Please complete this section explaining how your proposed activities are compliant)*

- **Have measures been put in place to ensure equal and meaningful opportunities for people of different genders to be involved throughout the project? This includes the development of the project, the participants of the research and the beneficiaries of the research.**

This project has an interface between Engineering and applications of engineering in a social environment. It is far easier to provide opportunities to women in social projects in Europe and the Far East but it is difficult to find many women in Engineering on either side of the planet. The data shown in the picture clearly demonstrate that Indonesia and Malaysia, both well on their way to provide the opportunities to women and they are not very far off from the OECD average. We have one of the key team member in Malaysia a women and we have a clear policy to offer opportunities to any gender and gender-neutral person without prejudice and biases. We have several student women team members in Indonesia and Malaysia. Moreover, all three institutions are committed to offer equal opportunity to all skilled people suitable to contribute to the project, hence are compliant to gender equality.

Fair play
More women in the workforce can further boost Malaysia's growth prospects.
(in percent, 2016)

● Female participation rate ● Ratio to male participation rate
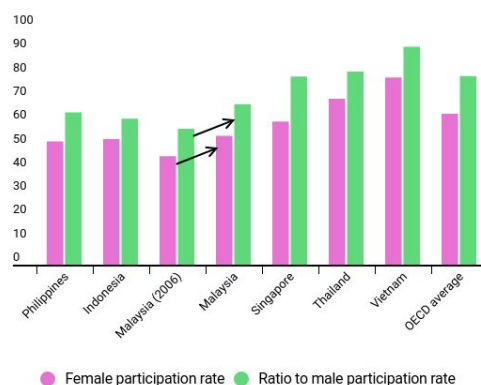
Sources: Department of Statistics, Malaysia; OECD.Stat; World Economic Forum, the Global Gender Gap Report, 2016; CEIC Data Co. Ltd.; and IMF staff calculations.

- **The expected impact of the project (benefits and losses) on people of different genders, both throughout the project and beyond.**

The internet access in rural areas has its benefits as well as there could be negative unintended consequence that we in the developed world are quite familiar. In a recent survey most older respondent from the remote village environments felt they were happy with life without any internet while in the same areas overwhelming majority of the digital natives, i.e. younger internet users, would look for high speed and broadband data networks. One benefit would be the more opportunities for the population who used to stay home, and that is likely be the women and older men. The negative affects includes the social disorder due to over access of information would results in intrusions and interferences in families' lives through social media. Another negative consequence could be the illegal content delivery and availability in a conservative religious country would generate reaction against technology and its associated people. This means the long-term impact could have issues that would need policing the content and saving people from scammer and fraudsters. However, the overall impact would be positive, especially for the female population to empowering them in commerce and enterprise and help them attaining respectable position in society.

- **The impact on the relations between people of different genders and people of the same gender. For example, changing roles and responsibilities in households, society, economy, politics, power, etc.**

One of the impact that could be anticipated for both gender is the family relationships of married couples. Indonesia has high ratio of married people and single male and female are always associated in a parental family structure. The availability of social media would enable widespread interactions between same and opposite gender and it is expected that a long-term impact would be the relaxation of these family structures. This is already taking place in the city areas and it will arrive in ruler areas too. However, on the upside, people will become more affluent making the country's GDP increment.

The largest proportion of females will benefit with this positive change, and it may also shift balance of breadwinners in society and as a result, some long-term structural changes can be envisaged.

- **How will any risks and unintended negative consequences on gender equality be avoided or mitigated against, and monitored?**

As we in the developed world have patience to establish the rule of law in every aspect of our society and Internet did prove to be the final wild west, where internet trolling and bullying is now considered seriously and bad behavior is becoming unacceptable. All these situations will develop in Indonesian villages too but due to existing examples and mitigating technologies and law enforcement agencies working in harmony with service providers, they would solve these issues far more quickly than we have had done. We all know online bulling is not easy to recognize but we know a large majority affected is female and this would be a challenge to be aware of this and to put in place rules at the very start to mitigate the situation to arise. This include to educate the local population through none internet means that is through meetings, social events and schools so they are able to recognize the dangers and then know exactly how to deal at early stages. Once families become aware of the challenges, then it would be simpler to recognize the telltale signs of abuses and it would be far easy in Indonesian society because of strong family structures.

- **Are there any relevant outcomes and outputs being measured, with data disaggregated by age and gender (where disclosed)?**

Most of our data collection will be based on the engineering designs of the antennae and their performance correctly in the environment but we anticipate that the publicity of the project will bring data indicating the gender subscription. We will take note of this data from the public domain and it will be reported in the final report.

GCRF funding requested (Costings should be at 100% FEC)		
Directly allocated staff costs *(e.g. the PI and Co-investigator costs, where they have an academic level open ended contract, and time spent on the proposal will be estimated - please include superannuation & NI – for each person – please indicate name, months and % if part-time)*		**£3964.50**
Directly incurred staff costs *(e.g. research fellow and technician costs, where their time working will be traceable in an auditable record - please include superannuation & NI – for each person – please indicate name, months and % if part-time)*		

Travel & subsistence: *(please specify what this funding will be used for)*
 	
Travel In the UK
Local Travel Cost in the U.K. (Domestic Flight, Taxi, Bus, etc) for attending/hosting conference/meeting/visit/fieldwork**- £0**
 	
Travel to Indonesia (Dr Ata Khalid, UK PI)
 	
Attending Meeting/Visit/Discussion, Knowledge Sharing (Workshop) and Test Bed (Fieldwork) in Malaysia and Indonesia
   a) Subsistence (including Transportation)
      £750 x 2 visit = **£1,500** (based on 7 days per visit)
   b) Return Air Ticket (Return ticket between UK and Malaysia)
      £700 x 2 visit = **£1400**
   c) Air Ticket (Return ticket between Indonesia and Malaysia)
      £200 x 1 visit = **£200**
 	
Travel to the Indonesia (Dr Ramlee Kamarudin, Malaysia, Co-I 1 & Co-I 2 Dr Fauziahanim Che Seman)
 	
Attending Meeting/Visit/Discussion and Sensor/Antenna Measurement and system verification in the Indonesia.
   • Return Air Ticket (to Indonesia from Malaysia)
      £200 x 2 person x 1 visit = **£400**
   • Local travel and field work
      £500
 	
Travel to Malaysia (Dr Evizal, Indonesia, Co-I 3)
 	
Attending Meeting/Visit/Discussion and Sensor/Antenna Measurement and system verification in Malaysia
 	
   • Return Air Ticket (to Malaysia from Indonesia)
      £200 x 1 person x 1 visit = **£200**
		£4200.00

	Equipment and consumables: *(please specify what this funding will be used for)*				**£2500**

LIST OF COMPONENTS

No	Description	Quantity	Price (GBP)	Total (GBP)
1	Routerboard module	4	75	300
2	Enclouser PVD (outdoor)	2	30	60
3	Rogers Duroid board for antenna	2	50	100
4	Powersupply, PoE and accessories	2	43	86
5	Ethernet cable cat.6 (1 box)	1	95	95
6	Antenna fabrication accessories	1	85	85
7	Connector, coaxial cable, etc	1	150	150
8	Access point unit	3	65	195
9	Mini PtP link	2	78	156
10	Network swicth gigabits	1	115	115
11	Network switch	2	45	90
12	Solar panel system for backup power	2	210	420
13	Battery for backup power	2	55	110
14	Point to point mounting accessories	2	50	100
15	Access point mouting accessories	3	40	120
16	Site survey and testing	1	200	200
17	Miscelineous fees	1	112	112
	TOTAL		GBP	2500

Other: *(please explain any other funding requested, e.g. bench fees, facility access, venue booking fees, etc)*	**£500.00**
Indirect costs, estates and lab tech infrastructure	**£3192.66**
Total funding requested:	**£14357.16**

Will any requested funding be transferred to an overseas partner? *(If yes, please give specific details)*	**Yes**
Travel to the Indonesia (Dr Ramlee Kamarudin & Dr Fauziahanim Che Seman, Malaysia, Co-I 1&2)	**The budget for Travelling, Raw Materials and Fabrication will be transferred to both Co-Applicants. The procurement of raw materials and the cost for fabrication for the development of wireless network bridging are much cheaper in Malaysia and Indonesia.**
Attending Meeting/Visit/Discussion and Sensor/Antenna Measurement and system verification in the Indonesia. • *Return Air Ticket (to Indonesia from Malaysia)* *£200 x 2 person x 1 visit = £400* • *Local travel and field work* *£500*	
Travel to Malaysia (Dr Evizal, Indonesia, Co-I 3)	
Attending Meeting/Visit/Discussion and Sensor/Antenna Measurement and system verification in Malaysia • *Return Air Ticket (to Malaysia from Indonesia)* *£200 x 1 person x 1 visit = £200* ***Total travel cost for Co-Investigators £1100***	
Consumable and components purchase in Malaysia ***Total as given detailed above = £2500***	
Grand total funds transfer to Co-Applicant = £1100 + £2500 = £3600	

Justification of resources

A: Directly allocated staff costs

Permanent staff costs which include the Principal Investigator (will 8% his time for this project for 9 months)

The total request is: £3964.50

B: Travel & subsistence

The operational costs for the UK partner include return flight from the UK for Dr Ata Khalid (PI) to Indonesia and Malaysia, for discussion, meetings and events in both Indonesia and Malaysia, travel within Malaysia, Indonesia, and allowable subsistence.

The operational cost for travelling Co-investigator 1, Dr Ramlee Kamarudin (Malaysia) and Co-investigator 2, Dr Fauziahanim Che Seman to Indonesia to do some fieldwork and system verification, meeting, discussion, and holing technical workshops, and Dr. Evizal Abdul Kadir (Indonesia), costs include air ticket, accommodation, and others cost during the visit.

The total request is: £4200

C: Equipment and consumables

The research-related costs include consumables such as raw materials and components to develop the system and some fieldworks (sensor testing and measurement) in Malaysia and Indonesia. A high frequency system will be designed at Cranfield and Specialist Microwave Solutions limited UK using component purchased in Malaysia, developed in PI's lab in Cranfield, and will be verified in the UK before taken to Indonesia.

The total request is: £2,500

D: Other

Cost associated with Conference Organisation: 500.00

Declarations	
☒ I understand that the funding must be spent by 31st July 2020	
☒ I agree to provide a report on my project activity, outcomes and impact by 31st August 2020	

Authorisations (Electronic signatures or email approvals are sufficient)	
Signature of applicant: *Ata Khalid*	**Date:** 23/09/2019
Signature of Line Manager / Head of Centre:	**Date:**
Signature of Director of Theme:	**Date:**

Completed applications accompanied with the necessary approvals must be submitted to researchoffice@cranfield.ac.uk by 16:00 on the 23rd September 2019.

Late or incomplete applications will not be considered.

If you have any queries, please email researchoffice@cranfield.ac.uk and a member of the grants team will respond to you as soon as possible.