Section 0 - New Page

Name of Award-holder

Please state your name

PROFESSOR SIMON MARVIN

Award-holder organisation

Please state the name of the organisation at which the award was held. If the award was transferred during the course of the award, please state the names of all organisations at which the award was held during its course.

UNIVERSITY OF SHEFFIELD

Title of research project

Please provide the title of your award

Drones/Robotics and Development Priorities in Africa: Transformative infrastructure or digital colonisation?

Research Summary: Please provide a summary (in a non-specialist language) of what you set out to achieve with this project and the key findings of your research. To what extent did your research generate new knowledge or fill gaps in existing knowledge? The British Academy may publish this summary on its website and/or otherwise use it to promote this programme or more broadly the research that it funds.

The research had three objectives:

1. use a range of emblematic sites and projects to explore how knowledge, practice and material technology is being assembled and transferred and what that means for infrastructure and service delivery across different domains including health, freight distribution, mapping and disaster response.

2. examine how Africa's drone infrastructure is seen by different public and private interests and organisations within and outside Africa.

3. investigate possible threats, opportunities and limitations associated with the extended application of drones in Africa and globally and the learning between these contexts.

The project generated new knowledge in the area by undertaking the following research:
1. Desk-based mapping of projects and drone development in Africa. Undertaking desk-based mapping drawing primarily upon internet sources, supplemented by material generated through the primary research interviews provided an overview of the key sites undertaking drone experimentation in Africa. This confirmed that critically Malawi, Rwanda and Tanzania were key test beds for both commercial and developmental experimentation with drone delivery and confirmed their role as case study locations. Additionally, the mapping exercise revealed a much longer history of humanitarian drone experimentation in the South African context with demonstrations and test beds developed into working systems in the 1990s. This became a focus for further work.

2. Interviews with international agencies responsible for drone experimentation including MSF, UNFPA, UNICEF, USAID, the Gates Foundation and the Rockefeller Foundation to map and understand more about networks of knowledge and practice and future priorities (10 interviews, by telephone/ Skype). These revealed the diversity of drone experiments in Africa and the differences between commercial applications primarily focused on humanitarian aid and the role of charities and development agencies primarily

focusing on drone as a training and small business development opportunity. Our research was primarily focused on the humanitarian logic and commercial partnerships

3. In-depth case studies of globally significant sites and initiatives for drone experimentation in Rwanda and Tanzania. The case studies examined diverse regulatory, infrastructural and techno-social contexts of robotic experimentation in a range of drone delivery projects across Rwanda and Tanzania. Each national case involved an initial exploratory visit and then a follow on of two weeks of interviews and site visits to sites of drone infrastructural/service activity. In each case 20 interviews were undertaken (rather than 10 planned) with relevant NGOs, health agencies, governments and private operators. Site visits to a central urban and one remote drone site in each country allowed us to observe operations and undertake further semi-structured interviews and with operators, logistics, technicians, health professionals and service delivery users.

• The Rwanda case study focused on the country's innovative framework of blood transfusion and medical supply delivery that is operated by the US firm Zipline under contract to the Rwandan government. Interviews were undertaken with national government departments in Kigali and also with Zipline operators in the Southern district of Muhanga (where the Zipline facility is based, transporting blood and medical supplies to 21 transfusion clinics). Sites visits and interviews were also undertaken in two hospitals that benefited from drone delivery. The research examined the political arrangements behind the project, the practical issues in establishing and running the Zipline project, the implications for airspace regulation and plans for the future development of drone infrastructure in Rwnada.

• Tanzania initially focused on Zipline's partnership with the Tanzania Ministry of Health and the Medical Stores Department to open four distribution centres in Tanzania, which has been abandoned. Interviews were undertaken with key stakeholders in this process, and those involved in a subsequent medical delivery trial with the German drone company Wingcopter, between Tanzania's second largest city Mwanza and the island of Ukerewe on Lake Victoria. In addition to this case study, interviews were carried out in Dar es Salaam and Zanzibar City with actors involved in the Lake Victoria Challenge (an international showcase of African drone innovation hosted in Mwanza) and the Zanzibar Mapping Initiative (a government-led partnership mapping the whole of Zanzibar using drones). Interviews were conducted with 20 government officials, regulators, donor organisations and NGOs, consultants, technology companies, drone operators and pilots. As well as the case studies, these interviews examined issues of regulation and uncertainty, the context-specific constraints and opportunities for using drones, and what is needed to develop a viable domestic drone sector in Tanzania.

4. Research on drone technology and frameworks for urban robotic delivery (California) – fourteen interviews were undertaken in California with a range of firms and organisations involved in developing technology for drone delivery and urban governments involved in the regulation of urban drone and robotic delivery systems. Zipline was intended as a key focus for the California research. The company's vision is to ultimately establish the "instant global delivery system" and the company is based in California. However the California research encompassed internationally significant initiatives to facilitate and manage urban robotic and drone applications in Palo Alto and San Francisco. The California research also coincided with new federal frameworks to support drone delivery experiments in selected sites across the USA.

5. Start up meeting and dissemination workshops – the project started with a set up workshop in Cape Town involving the UK research team, our research partners in Cape Town (University of Cape Town African Centre for Cities), policy makers and technology firms. Two Advisory Board meetings were held during the project to help support the field work and test the emerging conclusions.

Lessons Learnt: Please comment on the key lessons learnt from the implementation of the project. To what extent did you achieve the objectives set in your original proposal? You should highlight any

unexpected or unintended consequences that occurred from your original work plan or any delays suffered and the effects of these on your project. Equally, you should detail any unexpected successes.

The research achieved and in many respects exceeded the objectives set out in the original proposal, especially in terms of the depth of empirical research and quality of academic outputs. Unexpected delays in securing research clearance in each country meant that the research focused on two countries (Rwanda and Tanzania) with no field research in the proposed third research site (Malawi). However with hindsight the research benefitted from the additional time and resource devoted to Rwanda and Tanzania and those two countries were a useful point of comparison (government facilitated drone experiment in Rwanda, constraints on drone development in Tanzania). Also (see below) the research process was enhanced by the complicated processes of securing research visa, notably the need for two visits to each country, which was not originally intended. An unexpected success was the uncovering of significant experimentation in regulatory frameworks for robotics and drone delivery in California. The research also opened up potential research in related technological applications, notably technologies for and experiments with Controlled Environment Agriculture in Africa.

There were three key lessons learnt from the project in relation to the research process:
a) Research Visas and research access in Africa – the process for obtaining research visa for the African case studies was protracted and heavily delayed. This meant we were unable to stick to the original timetable designed for the research based. It was important to mobilise research and other professional contacts in order to eventually ensure the proper authorisation to undertake the research work. Given the length of time to obtain research visas we undertook two country visits – the first for fact finding and establishing contacts and the second to undertake formal interviews with participants. Unexpectedly this approach was extremely effective in helping finesse the research visa process, obtaining access, the trust and participation of key respondents and in improving the quality and effectiveness of the research undertaken. In each of the case study areas we were able to undertake more interviews and gain access to many more stakeholders than was intended because of the dual visits.
b) Minor Case Study Changes - the original programme was to undertake work in Rwanda, Tanzania and Malawi. Because of the difficulty of obtaining the correct visas we were forced to re-assess our strategy. Initial fact finding visits in Rwanda and Tanzania were successful in creating the conditions for obtaining the correct visa requirements. However, it became clear that Malawi would be more problematic. Consequently, we undertook additional work on the the history and recent developments of commercial drone applications in South Africa and were able to do more in-depth work in both Rwanda and Tanzania. In our view the risk of undertaking research in Malawi without proper visa authorisation was too high for the researchers.
c) Allow sufficient time and resources for in-depth research - issues with visa clearance meant that the research team devoted more time and resources to field research and that significant broadened and deepened the research.

⬇ **FES DRONES BA**

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Outcomes and Impact

There is considerable interest in the potential for humanitarian drone delivery in Africa and across the world. However drone delivery has been constrained by concerns about airspace regulation, health and safety and cost effectiveness. Africa has been seen as a key test bed for innovative drone experimentation but in practice there has been very limited project development, with many countries banning drone experiments.

Our Rwandan case study provides in-depth understanding of perhaps the most significant African (and global) drone delivery experiment. Our research uncovered the full history of the initiative and provides a series of insights and lessons on good practice in addressing concerns about health and safety and creating space for drones within existing airspace regulation. Our research went deeper and beyond the accounts of the Rwandan Zipline operation and as such it should be of interest and value to governments, firms and organisations involved in drone delivery technology and initiatives across the world.

The Tanzania case study helped highlight important barriers to drone delivery in a country that is supportive of the drone delivery agenda. In this respect it was important to explore different potential sites of drone experimentation.

The California research supplemented the Africa research but also explored evidence of the early development of a globally important framework for facilitating responsible urban drone and robotic intervention in city of San Francisco and greater openness to drone experimentation at the federal leve; in the USA. Both initiatives are internationally leading.

To summarise, the three key outcomes and impacts from the project are:

1. Providing in-depth analysis of globally significant (and renowned) initiatives and sites of humanitarian drone delivery experimentation helping to inform ongoing policy discussions within governments, aid agencies, firms and research organisation. The research has extended media understanding of drone

delivery, providing a more robust evidence base for decision making.

2. Developing conceptual and empirical understanding of the general issues raised by 'making space' for drones, including issues of airspace regulation and the relationship between facilities on the ground, maintenance and flightpaths.

3. There is potential for considerable academic and non-academic impact through project publications as well as scope for important follow-on research in Africa and globally.

ODA Eligibility: Please explain how your project has contributed to promoting the economic and social welfare of developing countries.

There is significant potential for drone delivery to support humanitarian goal, social welfare and economic development in Africa and developing countries internationally. The research has substantially extended the evidence base for understanding the advantages, challenges and good practice solutions in developing drone delivery infrastructure at a time when many developing countries are concerned about issues of security and safety associated with the new drone technology. The research demonstrates the value of drone delivery and provides a range of insights and good practice guidance in overcoming barriers to drone delivery in developing countries.

Safeguarding: Please use this section to outline any safeguarding and/or child protection incidents which occurred in relation to or as a result of your project. If no incidents occurred, please respond with 'NIL RETURN'.

NIL RETURN

No-Cost Extension (if applicable): Please note the length of the no-cost extension you were granted, and comment on what this extension enabled you to achieve with your award, which you would not have been able to achieve had the extension not been granted.

NIL

Research and Professional Development: How has this award been beneficial to your research and professional development? If this award has contributed to your securing another grant to build on this project further, or pursue related research, please indicate the name and size of the grant secured.

The research project was an important and integral part of the research team's development of a research agenda on the potential for new robotic infrastructure (the agenda is one of the research themes of the Urban Institute, University of Sheffield, of which Simon Marvin is director). The research team is pioneering research in this emerging field and the British Academy research has both consolidated and extended the development of the theme in important ways, including: (a) the development of conceptual frameworks and understanding grounded in empirical study; (b) important new empirical evidence to support the academic and non-academic impact of the research theme; (c) opening up new sites for research and new understanding of the core research issues; and (d) broadening and deepening our contacts with academics and policy-makers in Africa, Europe, the UK and North America. There are plans to submit funding bids to UK research councils and other funders (e.g. Leverhulme) that extend the African research.