Industry-linked Projects and Research-informed-and-enriched Curriculum for Sustainable Student Employability Metrics

Sunday Ekpo

BEng (Hons), CEng, PGCAP, MA, MSc, PhD, MIET, MIEEE, MAIAA, FHEA

S.Ekpo@mmu.ac.uk; scekpo@theiet.org; scekpo@ieee.org; T.: +44(0)161 247 6229; M.: +44(0)74 8434 7419

Smart Infrastructure and Industry Research Centre

Outline

- Background and Expertise;
- Industry-linked R&D Engineering Experience;
- Industry-linked Engineering Pedagogy:
  - Research-informed-and-enriched (RIE) Learning and Teaching;
  - Evidence-based RIE Project Supervision;
  - Evidence-based RIE Curriculum Design.
- Conclusion; and
- Potential Industry-linked HE STEM Collaboration Opportunities.

Background and Expertise

- **50+ peer-reviewed and refereed technical publications;**
- **RF, Microwave & mmWave Communication Systems Engineering;**
- **Microelectronics and Nanostructures;**
- **Optoelectronics & Optical Fibre/Free Space Optics Communication;**
- **Communication Transceiver Front-end Characterisation; and**
- **Adaptive Spacecraft Systems Engineering & Mission Analysis:**
  - **Subsystems Design, Modelling, Simulation, Prototyping and Integration.**

10+ years R&T experience !

- Telecommunications Network Design;
- Heterogeneous Wireless Networks Design;
- Advanced Digital Communication and DSP;
- Mobile Communications;
- Electronic Systems Design; and
- Antennas and Propagation Engineering.

- Electrical Power Gen & Systems Analysis;
- EPS Protection, Planning & Operations;
- Complex Systems Engineering Modelling;
- Control Theory & Engineering;
- Electrical & Telecoms Services Design; and
- Circuit-emulating Embedded Systems Design.

Senior Lecturer in Electrical & Electronic Engineering

Principal Researcher/RA (Jaguar Land Rover F-Type CV Project - Manchester Met);
Aviation Industry: Electrical & Electronic Engineer (IADC Ltd/DynCorp Int'l LLC);
Oil & Gas Industry: Electrical & Electronic Engineer (ExxonMobil Corporation);
Consulting Engineer (Don Manuel & Associates).

Outline

- Background and Expertise;
- Industry-linked R&D Engineering Experience;
- Industry-linked Engineering Pedagogy:
  - Research-informed-and-enriched (RIE) Learning and Teaching;
  - Evidence-based RIE Project Supervision;
  - Evidence-based RIE Curriculum Design.
- Conclusion;
- Potential Industry-linked HE STEM Collaboration Opportunities.

Industry-linked Research Works and Interests I

- RF, Microwave and Millimetre-wave Devices:
  - GaAs pHEMT Low-Noise Amplifiers;
  - GaN/SiC HEMT Power Amplifiers;
  - Reconfigurable/Tunable Switches;
  - Hybrid Power Dividers and Combiners;
  - Reconfigurable Power Dividers.
- MIMO, SISO, MISO & SIMO Antennas for 5G;
- Satellite Broadcast Solutions Manufacturing;
- RF Antenna Biosensors Development;
- Industrial IoTs Sensors Characterisation;
- Fibre-Integrated Reception System;
- Circuit-emulating Embedded Systems Design.

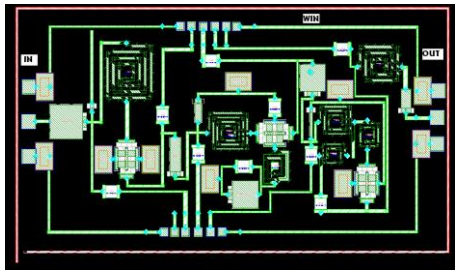
Wireline & Wireless Comms;
Industry 4.0 & Smart Manufacturing;
Water and Energy Resources;
Smart Cities.

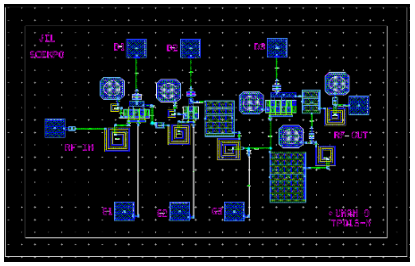
Healthcare;
Transportation;
Sustainable Infrastructure;
Environmental Monitoring.

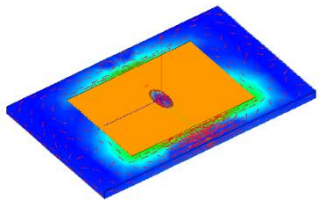
New Research Interests

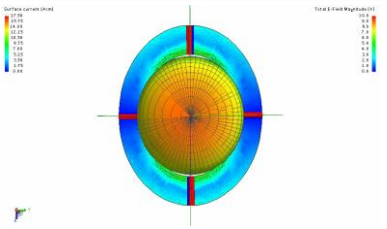
- **Adaptive Physical Layer Security of Radio Communication Interfaces;**
- **RF/Microwave Biosensor Development for Breast Cancer Diagnosis;**
- **Artificial Intelligence Integration in Long-range Passive RFIDs & RF Front-ends;**
- **Reconfigurable RF Antenna Development for 5G and Industry 4.0 Applications;**
- **5G-enabled Simultaneous Wireless Information and Power Transfer; and**
- **Reconfigurable Microwave Isolators, Circulators and Switches.**

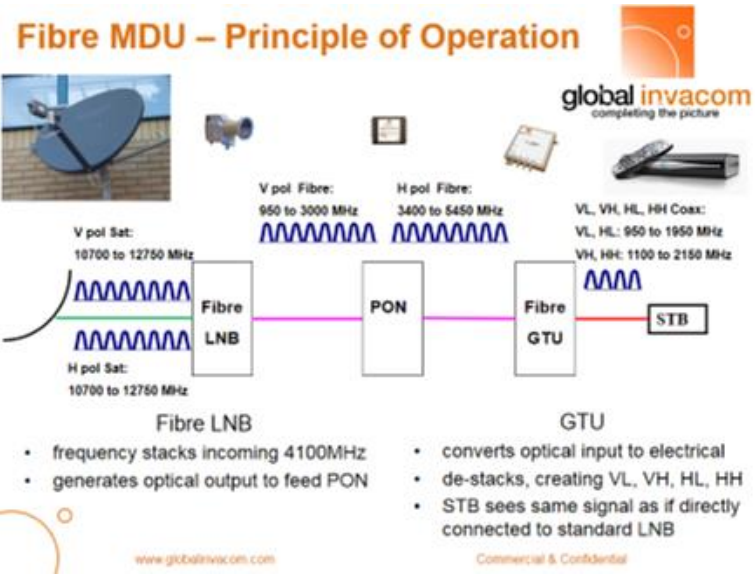
Industry-linked Research Works and Interests II

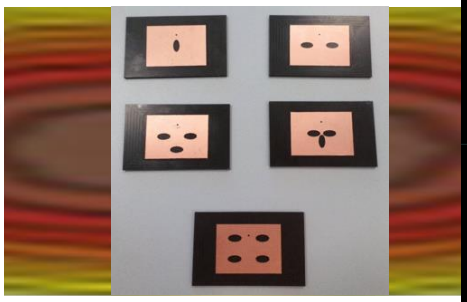


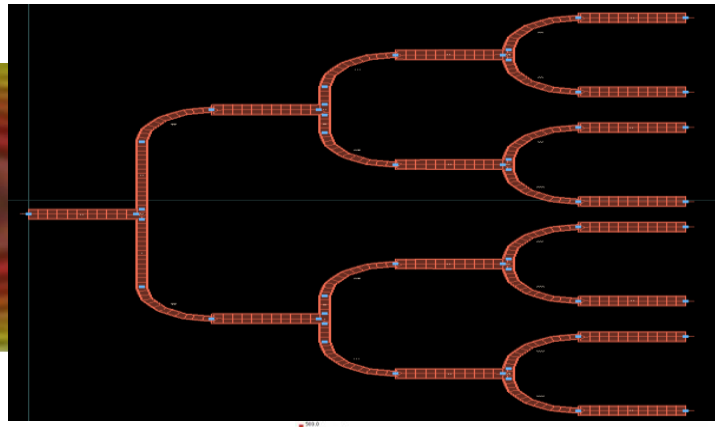


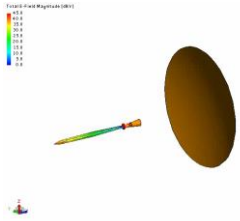


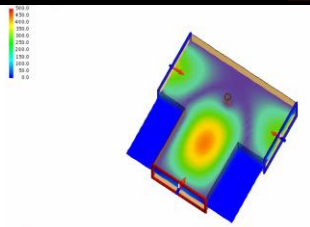


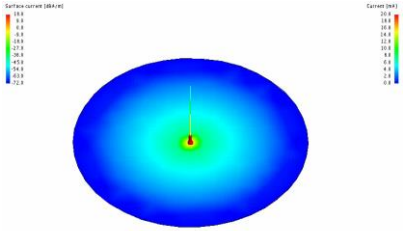


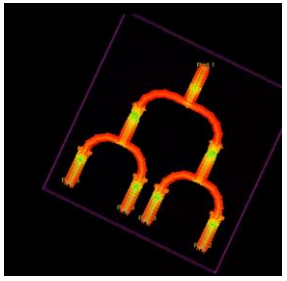


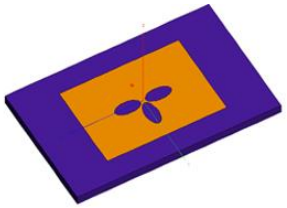


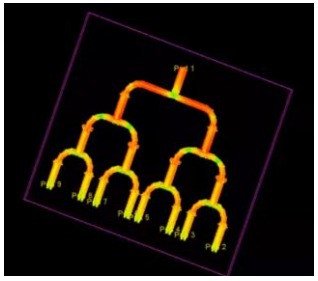


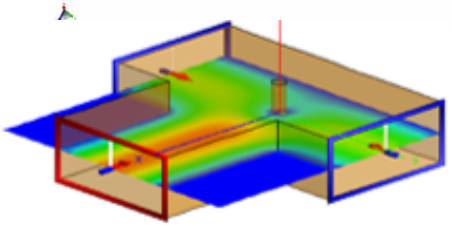










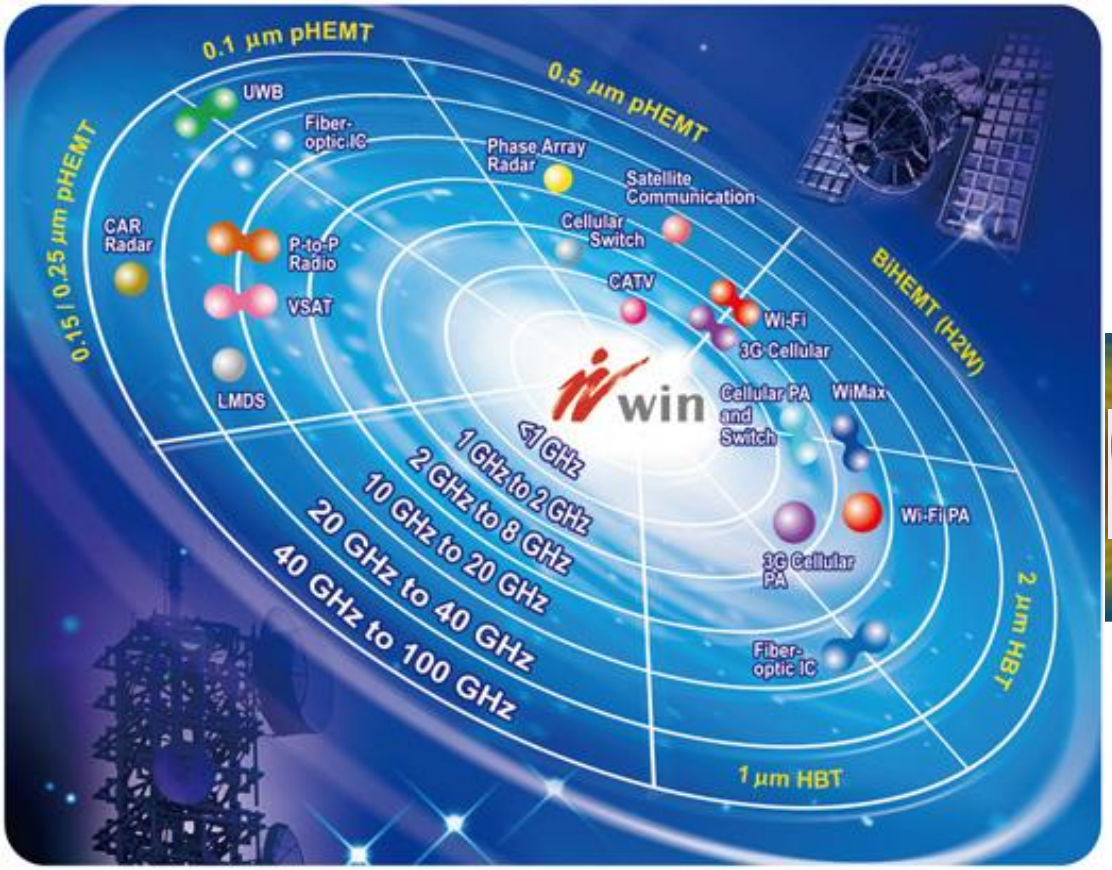


Communication and Space Systems Engineering Research Team

Industry-linked & Academic R&D Collaborations

SONY

global invacom
completing the picture



avanti

microlease

GMCA GREATER MANCHESTER COMBINED AUTHORITY

spirent
Promise. Assured.

KEYSIGHT TECHNOLOGIES

SmOp Smart Optimised Clean Tech

ANSYS

HUAWEI

unifi.id
Movement Intelligence

win Leading Global Communications SEMICONDUCTORS

Modelithics®
World's Best RF & Microwave Simulation Models

Cape Peninsula University of Technology

Sheffield Hallam University

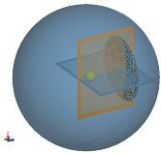
UNIVERSITY OF SURREY

Jeff Gosling
Hand Controls Ltd.
1988-2018 | Celebrating 30 years

University of Venda

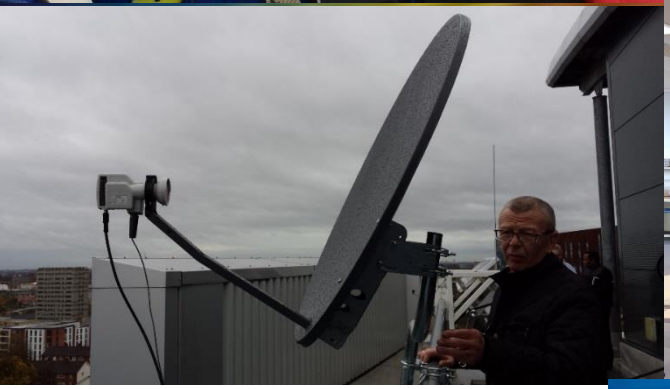
SCEkpo | Advance HE STEM Conference 2020, Manchester, UK | 29-30.01.2020

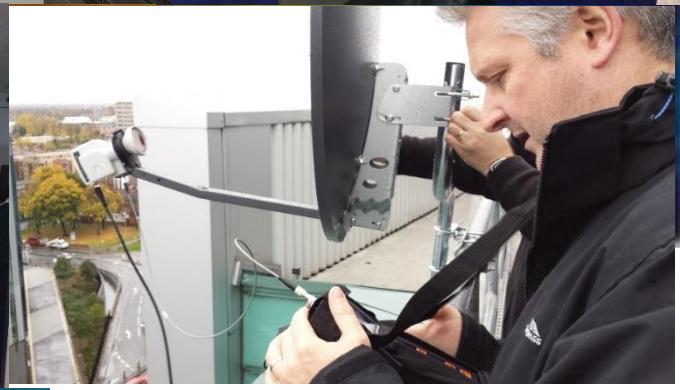
Manchester Metropolitan University



Communication & Space Systems Engineering Team





Outline

- Background and Expertise;
- Industry-linked R&D Engineering Experience;
- Industry-linked Engineering Pedagogy:
  - Research-informed-and-enriched (RIE) Learning and Teaching;
  - Evidence-based RIE Project Supervision;
  - Evidence-based RIE Curriculum Design.
- Conclusion;
- Potential Industry-linked HE STEM Collaboration Opportunities.

Industry-linked RIE Learning & Teaching

- **Why industry-linked engineering pedagogy?**
  - An ***educational metrics root cause analysis*** opportunity creation;
  - A systematic approach to **student experience lifecycle** reflection;
  - Focus is shifted from individual learners and teachers onto the educational system:
    - to help build an ***open*** and ***fair culture***:
  - Increases an awareness of **modern educational metrics** and **curriculum design** issues;
  - Allows for **engagement** of both **staff members** and **students** in the i**nclusive** and **proactive value-driven** L&T process.

Evidence-based RIE Curriculum Design

Learning and teaching contents reflect modern engineering;
Industry-linked inputs to deliver beyond learning outcomes threshold.

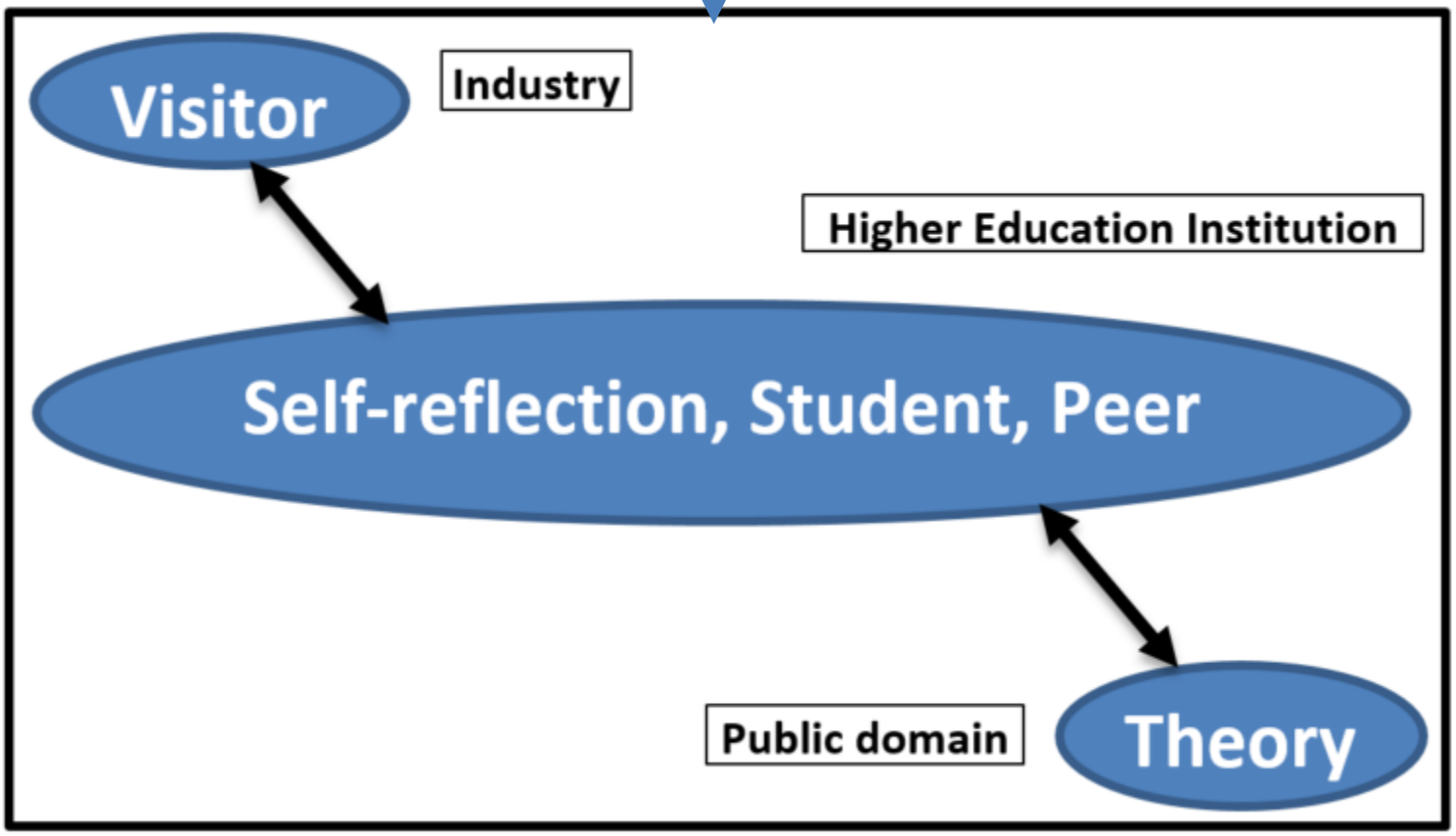


Figure 1. Teaching-based RIE Model of Reflection

Industry-linked Education Programme: RIE L&T

Case Study: Unit Design and Assessment

- Unit is constructively-aligned with assessments;
- RIE lecture, workshop and tutorial sessions;
- Examination and coursework reflect modern engineering;
- Industrial partners co-deliver specialist contents; and
- IET's AHEP learning outcomes and CEng engineering competences are emphasised.

Evidence-based RIE Project Supervision I

Table 1. Factors motivating student's choice of supervisor and/or their research project

Supervisor & Project Choice Factor	Respondents' Response											Response (%)
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	
Industrial link and sponsorship	Y				Y		Y				Y	36.36
Opportunities to learn new technology and applications	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	90.91
The profile of the research team				Y	Y			Y	Y			36.36
Availability and support of your supervisor			Y	Y		Y	Y	Y			Y	54.55
Rigour and technical depth of the project			Y	Y	Y		Y				Y	45.45
Future career prospects and professional practice		Y		Y	Y		Y			Y	Y	54.55
Training offered by the industrial partner(s) and project sponsor(s)				Y			Y					18.18
Other (please, state them):												0.0

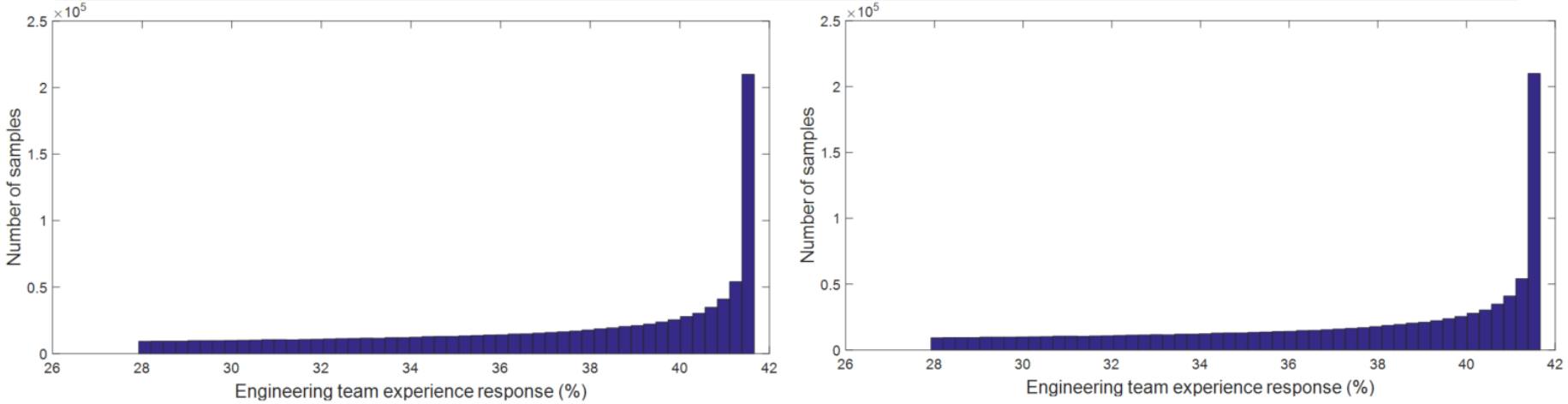


Figure 2. Monte Carlo Simulations of Student Project Experience

Sunday Ekpo (2018), Formative Assessment and Feedback: A Tool for Student Engagement in Engineering Students' Projects, *MA in Higher Education Dissertation Report*, Manchester Metropolitan University, pp. 1 – 81.

Evidence-based RIE Project Supervision II

Table 2. Descriptive statistics of the students' project experience

Project experience ID	Descriptive statistics		Positive response (%)
	Mean	SD	
PE1 (Research Team Experience)	4.18	0.87	80.4
PE2 (Engineering Team Experience)	3.73	1.19	68.3
PE3 (Usefulness of Mock Project Presentation)	4.64	0.67	94.1
PE4 (Usefulness of your supervisor's feedback towards your research project)	4.27	0.79	87.2
PE5 (Usefulness of working with professional engineers during research project implementation)	3.91	1.04	74.4
PE6 (Usefulness of project supervisor's feedback towards your research project engagement)	4.00	0.89	72.2

Sunday Ekpo (2018), Formative Assessment and Feedback: A Tool for Student Engagement in Engineering Students' Projects, *MA in Higher Education Dissertation Report*, Manchester Metropolitan University, pp. 1 – 81.

Evidence-based RIE Project Supervision III

Independent engineering project alignment with research themes;
Industry-linked inputs to define project aim, objectives and scope.

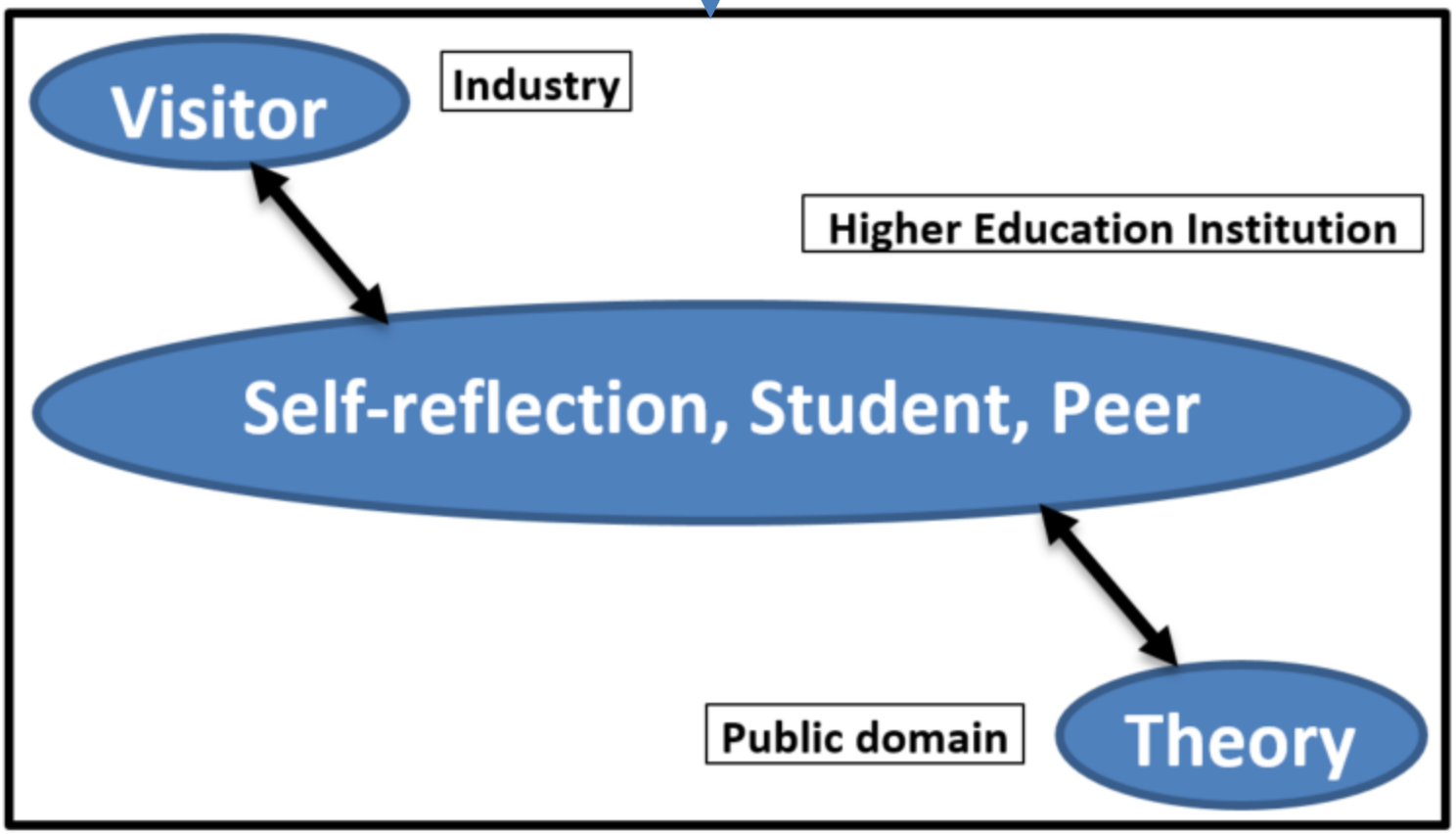


Figure 3. Project-based RIE Model of Reflection

Impact and Outcomes I

- Real University-Industry alignment for future engineers;
- 100 % of taught and supervised students:
  - Gain employment into the industry; and/or
  - Embark on further education (MSc and PhD).
- Supervised UG & MSc students work with University's industrial partners via:
  - Jobs for students;
  - Industrial placement;
  - Knowledge transfer partnership;
  - Sponsored PGR studentships – MRes/MPhil/PhD;
  - Industry linked R&D.
- Technical publications with the students;
- Contribution to REF and TEF metrics of the University.

Impact and Outcomes II

Table 3. Student Project Engagement Improvement Assessment

Assessment Level	Mean (%)	Student Engagement Factor improvement (%)	Inverse cumulative distribution function at 10% Upper Boundary Threshold
Mock Presentation	63.3	-	74.6
Prelim Presentation	74	48	86.5
Project Review	85	70	93.1
Overall/Final	75	52	86.5

RiT: Industrial Partner's KTP Benefit Report

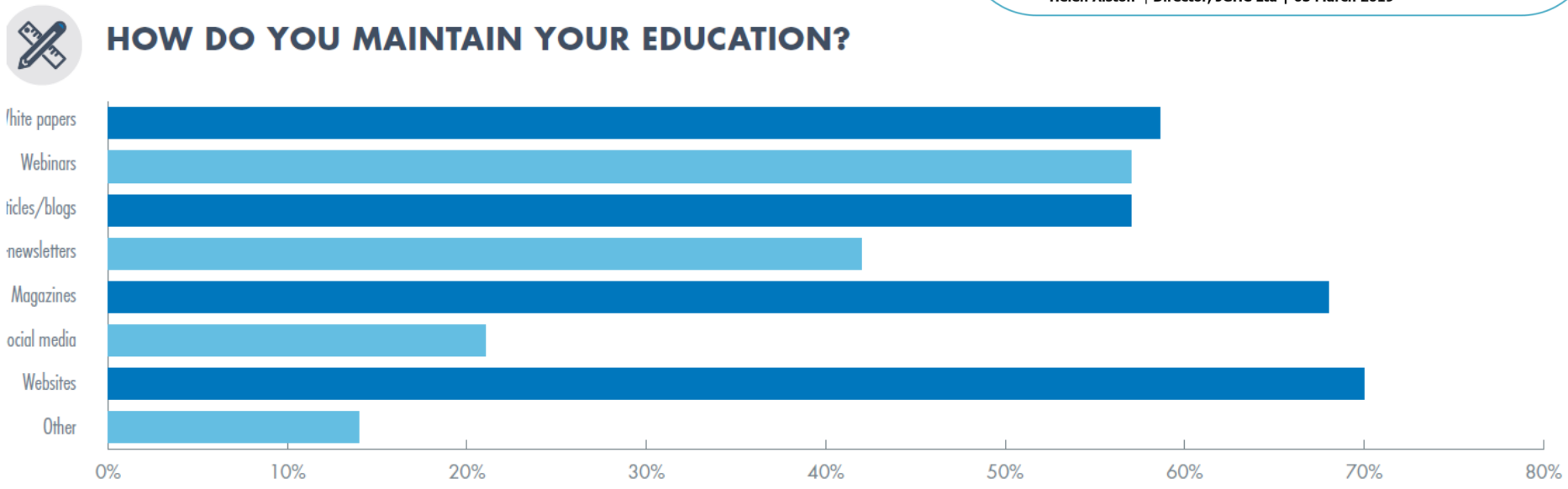
Solomon Udeshi (BEng (Hons) Electrical & Electronic Engineering) – 2016/17 Graduate
Achievement: First Class; Electronic Design Engineer/KTP Associate, JGHC Ltd

"The addition of Solomon to our team at Jeff Gosling Hand Controls (JGHC) has enabled us to investigate specific areas of vehicle communication further than we have previously. Solomon had some knowledge on and around the subject from his degree which he has been able to apply to the project. This prior knowledge has benefitted JGHC as Solomon has been able to take complex subjects and explain them clearly to members of staff who do not have the same prior understanding of the electronics behind vehicle communication. To do this he has used his excellent presentation and communication skills. Solomon has then worked both with colleagues at JGHC and on his own to further his knowledge on this specific subject. His ability to research, understand and then apply information has been key to advancing the project. As the project has continued, Solomon has then worked hands on producing items such as circuit boards and wiring looms to assist him with data acquisition. It has been beneficial that Solomon has brought with him the practical skills as well as the theory so he has not been hindered in the project by having to wait for others to do aspects of the work.

Solomon has added his knowledge which has then allowed JGHC staff members to engage their skills into the project. This has brought about a team driven project with many people focussed on reaching one target. As the project continues, with Solomon taking the lead, our knowledge base as a company is increasing which will hopefully lead to new products which will benefit both ourselves and our customers.

Many Thanks,

Helen Alston | Director, JGHC Ltd | 05 March 2019"



Carlos Gonzalez (2018) How do Engineers Stay So Smart? *Machine Design Publication*, pp. 1-3.

Impact and Outcomes III

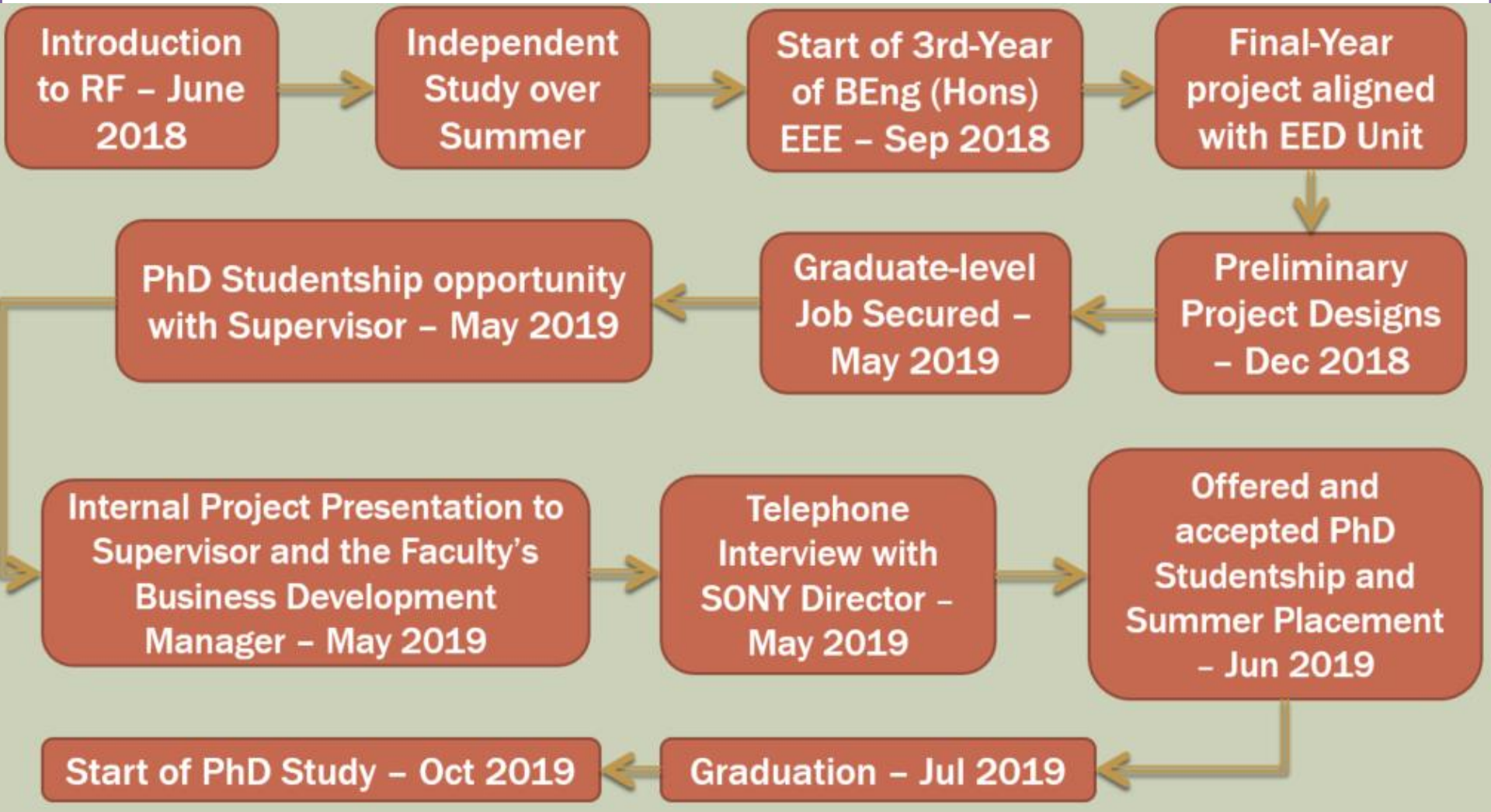


Figure 4. Industry-linked RIE Curriculum: Success Story of a Past Student Taught and Supervised

Outline

- Background and Expertise;
- Industry-linked R&D Engineering Experience;
- Industry-linked Engineering Pedagogy:
  - Research-informed-and-enriched (RIE) Learning and Teaching;
  - Evidence-based RIE Project Supervision;
  - Evidence-based RIE Curriculum Design.
- Conclusion;
- Potential Industry-linked HE STEM Collaboration Opportunities.

Conclusion

- **Students** are **passionate** about **learning** new ideas, technologies and applications;
- **Sustainability** is achieved by using an **established industry-linked RIE curriculum** model to:
  - ***Educate up-and-coming*** generations of ***engineering students***; and
  - Prepare ***graduating engineering students*** to ***stay smart*** post-graduation.
- **Industry-linked** engineering **pedagogy** improves **educational metrics** significantly;
- Enhanced **student engagement** in an engineering project improves learners' **achievements;** and
- **Student project** experiences should be modelled after **multidisciplinary research**:
  - that underpins the **research activities** within a **research centre**; and
  - creates **opportunities** to **learn** new **marketable skills**.

Outline

- Background and Expertise;
- Industry-linked R&D Engineering Experience;
- Industry-linked Engineering Pedagogy:
  - Research-informed-and-enriched (RIE) Learning and Teaching;
  - Evidence-based RIE Project Supervision;
  - Evidence-based RIE Curriculum Design.
- Conclusion;
- Potential Industry-linked HE STEM Collaboration Opportunities.

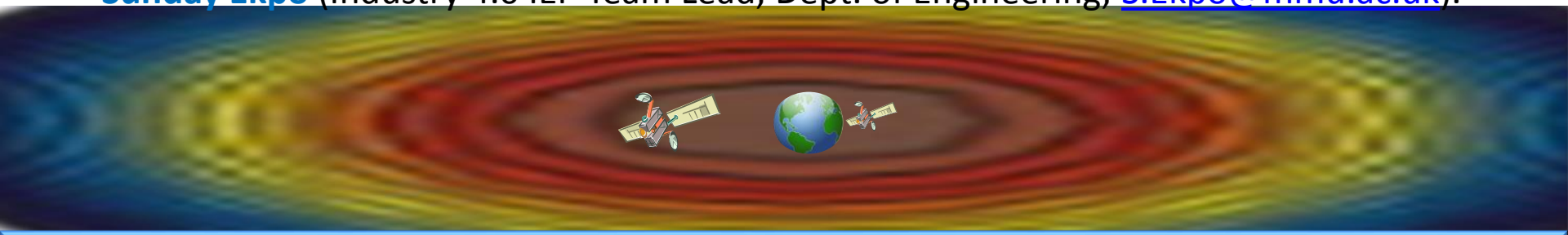
Potential STEM Collaboration Areas

- **Industry-linked Engineering Pedagogy** Curriculum Development;
- **Inclusive Student-centric** Pre- and Post-graduation Continuing **STEM Competences** Empowerment Research; and
- **Inclusive Teacher-centric** Continuing **STEM Competences** Development Research.

Thank You.

Engineering Pedagogy Curriculum Development Team

Margaret Fowler (Education Lead, Department of Engineering; M.Fowler@mmu.ac.uk);
Lisa Simmons (Project Chair, Department of Engineering; L.Simmons@mmu.ac.uk);
Muhammad Ijaz (UG Industry 4.0 Independent Eng. Projects Co-Facilitator; M.Ijaz@mmu.ac.uk);
Sunday Ekpo (Industry 4.0 IEP Team Lead, Dept. of Engineering; S.Ekpo@mmu.ac.uk).



Any Questions Please?