Institution: University of Lincoln

Unit of Assessment: 13 Architecture, Planning and Built Environment

1. Unit context and structure, research and impact strategy

1.1 Context and Structure

Research in Architecture, Planning and the Built Environment at Lincoln is based in the Lincoln School of Architecture and the Built Environment (LSABE). The School, one of six in the College of Arts (CoA), contains the disciplines of Architecture, Construction Science and Management (CSM) and Architectural Science and Technology (AST). The introduction of CSM and AST in recent years (2017 and 2019 respectively) has allowed the UoA to develop interdisciplinary and impactful research in its existing strength in sustainability and the sustainable built environment by enhancing its relations with key partners nationally and internationally. The inclusive research environment of the School has produced a diversity of research work ranging from the environmental performance of buildings and cities to construction science and management and cultural heritage.

1.2 Achievement of Research Strategy

The UoA set out seven key aims in its 2014 REF research strategy.

1) The **quality of research publications** and the **number of funding applications** have increased in this census period by putting in place a range of initiatives. In this round, all staff in the UoA have applied for research funding. The Unit supported this aim by putting in place a range of initiatives including: a mentoring scheme; annual research workshops 'Research Indaba' (starting 2016); prioritising new recruitments of research-active staff **(Sarhan, Zhao);** mentoring through an annual Individual Research Plan process (IRP); coaching staff to submit research funding bids and peer-reviewed high-quality publications annually; and monitoring achievements through the appraisal process.

2) Mentoring and Supporting ECRs: The Unit has been successful in formalising the ECR mentoring process. Through the IRP, staff list their research plans and are mentored and supported by senior academics **(Sodagar, Pretlove, Byrd, Elnokaly)** in the School to achieve their research targets and increase the impact of their research. In this census, initially, we appointed two ECR's **(Sarhan** and **Zhao)** who are now established researchers.

3)The **research income has increased** by a strategy focusing on increasing the number of bid submissions and providing support and mentorship to staff by the School, College and the University Research and Enterprise Office. The growth in the UoA's percentage income from 2013/14 to 2019/20 is 81%. Examples of funding secured include: **Elnokaly** in collaboration with the Lincoln Institute for Agri-Food Technology, the School of Engineering and the University of Reading secured a BBSRC project for a consortium (£166,200) in 2016-2019 to develop a third generation of polyethylene cladding materials for use in greenhouses. She was awarded four British Council Newton fund Researchers' and Travel Links Grants, totalling around £138,600; £25,000 (2015) to investigate waste management and material recycling as a potential of the sustainable building envelope for low-income housing in collaboration with the British University in Egypt (Section 4.1); £39,000 (2015/16) to look into rebuilding communities for resilient and sustainable development in collaboration with Cairo University; £39,600 (2017/2019) to investigate the cultural heritage and livelihoods of Bedouins of South Sinai (Nuweiba) to develop a framework for sustainable development in collaboration with Ainshams University; £35,000 (2014/ 2015) in collaboration with Naresuan University and colleagues in the School of Design looking at cultural heritage and developing a framework for flood risk management of heritage sites in Bangkok, Thailand. **Sarhan** and **Pretlove** obtained a grant (£25,000) in 2020 from the Building and Civil Engineering Charitable Trust to develop construction supply-chain management standards for improving occupational stress and

productivity in construction projects. In 2014, **Byrd** was successful in obtaining a British Academy BA/Leverhulme Small Research Grant (£ 5,800) investigating post-disaster power supply and power failure from both energy and political perspective.

4) The Unit has **maintained its success in securing Knowledge Transfer Partnerships** through further engaging and expanding the School's industry network. **Sodagar** secured a KTP in partnership with Floor and Wall Ltd. (£143,000) in 2017-2020 to develop a light-weight, portable structure where specialist coating operations can take place during inclement weather conditions.

5) Develop **internal and external interdisciplinary research and collaborations**. Members of the UoA have been successful in developing national and international interdisciplinary research and collaborations. Examples include **Byrd**'s collaboration with researchers from universities in New Zealand informing policy change concerning climate change in New Zealand. **Elnokaly** (with Prof Simon Pearson, the Lincoln Institute for Agri-Food Technology) collaborated on a multi-disciplinary project that developed a third generation of polyethylene cladding materials for use in greenhouses. The project engaged with industry partners (British Polythene Industries plc, Haygrove Ltd., Finlays Ltd., Berry Garden Ltd. and A Schulman Ltd.) and academic partners (University of Reading), and other colleagues from the School of Chemistry at the University of Lincoln and the research organisation East Malling Research). She collaborated on Interdisciplinary research work on cultural heritage as a catalyst for sustainable urban regeneration that underpins one of the UoA Impact Case Studies (ICS-1) with international partners as mentioned above (Section 1.2 (3)). Furthermore, **Elnokaly's** three Researchers' Link Grants allowed her the opportunity to develop external research collaborations with 15 universities and research organisations in Egypt, 14 universities in the UK and seven research institutes in Thailand. Across the University of Lincoln **Elnokaly** has collaborated with Schools of Engineering, Chemistry, Agriculture, Mathematics and Physics and the Lincoln International Business School on joint research projects. **Sarhan and Pretlove** worked with BAM Construct UK to investigate the causes and impacts of occupational stress in construction projects; this led to an Occupational Health Research Award (Section 1.2 (3)). **Kolakowski** has collaborated with East Midlands Earth Structures Society (EMESS a regional group under the wing of the International Commission on Monuments and Other Sites-UK Committee), to promote the potential of natural building techniques to the construction industry. This has triggered a research collaboration between **Kolakowski** and local company Millstone Restoration for developing a new method of construction of Mud and Stud walls that would meet current Building Regulations and Standards, supported via funding from an EU ESIF Innovation Voucher. **Sodagar**, with European partners, developed and secured two International Energy Agency (IEA) projects (IEA 71 and 80). IEA EBC Annex 71, 'Building energy performance assessment based on in-situ measurements', is a consortium of researchers from 14 universities and 24 research institutes developing theoretical models for predicting the energy performance of design and buildings using available monitored data. An example of the outputs of IEA EBC Annex 71 is **Sodagar's** publication in *Energy and Buildings* in collaboration with researchers from the Universities of KU Leuven and Antwerp and Belgium industrial partners VITO, Unit Smart Energy and Built Environment, and Energy Ville, Cities in Transition Section. This presented a first step in bridging the knowledge gap between predicted energy performance and actual monitoring results by analysing the capability of data-driven modelling based on on-site measurements to characterise the thermal performance of building envelopes. IEA EBC Annex 80 'Resilient cooling of buildings' brings together researchers from 15 Universities and 7 research institutes to develop low energy resilient cooling technologies for residential and small office buildings.

6) The number of **postgraduate research students** has **increased** in this census period, with five completions (there were none in REF 2014), and registrations rising from three at the census date in 2013 to six in 2020. The Unit aimed at increasing international research collaboration through joint PhD supervisions with our international partners. **Elnokaly** has jointly supervised four completions with Professors at the Federal University of Technology in Akure (FUTE) Nigeria and one completion with Professors from Assiut University, Egypt in this census

period, all registered at those partner institutions. Each of these students completed at least one year at Lincoln for their PhD research and contributed to our Research Indaba presentations. In addition, she secured a funded Channel Scheme PhD student through the Egyptian Ministry of HE that she jointly supervised with Professors in Egypt, as well as four funded students jointly supervised with Professors in Nigeria and Algeria.

7)The Unit has been successful in **establishing new research partnerships.** We have refocussed our geographical outreach building on our existing international research partnerships and expanded it to further territories (Please refer to 1.2(5)). All members of staff in our UoA have expanded their research partnerships with partners nationally and internationally (Please refer to 1.2(3, 4 & 5)).

1.3. Approach to Interdisciplinary Research

Throughout the census period, the UoA has prioritised interdisciplinary research and supported staff in developing and conducting it. In 2017 the University awarded **Sodagar** funding for a PhD to be conducted jointly with the School of Engineering to address the impact of the urban built form and urban density on building energy performance in different climates, complementing **Sodagar's** work with IEA as detailed above (Section 1.2(5)). Byrd's interdisciplinary collaboration with researchers from The University of Auckland and Massey University looking at climate change in New Zealand **(ICS 2). Elnokaly** has worked with the School of Mathematics and Physics to establish the Energy, Environment and Sustainability (EES) Interdisciplinary Research Group. This collaboration has run three successful research symposia over the last three years and has also resulted in joint supervision of two PhD students by **Elnokaly** and the School of Mathematics and Physics. **Elnokaly's** collaboration with the School of Chemistry on Heritage research projects looking at the application of Nanoparticles on building facades and in thermal insulation of buildings has produced three journal articles. **Byrd**'s research investigating the New Zealand Government plans for the rebuilding of Christchurch (following its destruction by earthquakes) placed particular emphasis on the potential for a low-carbon built environment.

The Unit benefits from a close collaboration with the Lincoln Institute of Advanced Studies (LIAS), a University initiative to promote and facilitate interdisciplinary research across the institution. This has enabled a series of projects, including **Elnokaly** and **Sodagar's** co-operation with researchers across the University on epistemological questions on the nature of justice in ecosystems, the nature of justice between humans, and the nature of justice in the biosphere. This resulted in the inauguration of the Lincoln Centre for Ecological Justice (LinCEJ) in 2020 which includes both **Elnokaly** and **Sodagar** as members. LinCEJ undertakes multi-disciplinary research that addresses the implications of Ecological Justice for the ontological, ethical, and epistemological roots of core concepts in disciplines as varied as architecture, ecology, geography, law and the visual arts, and runs a series of monthly interdisciplinary Lectures.

1.4. Achievement of Impact Strategy

The Unit's strategy, which aimed to make impact integral to research, has expanded beyond what is presented in the Unit's submitted Impact Case Studies. For example, **Sodagar's** work as part of IEA projects (Section 1.2(5) identifies sustainable low energy solutions for the built environment that have been taken up by the construction industry. **Elnokaly's** research on the Greenhouse cladding project (Section 1.2(5)) contributed to optically modifying the light incident upon a crop to drive commercial and environmental benefits to greenhouse producers. The project developed low-cost materials that have provided significant advantages to global greenhouse producers. In addition, **Elnokaly's** research supported by a range of externally funded projects helped several beneficiaries nationally and internationally to develop new and innovative regenerative solutions in the built environment. Her research informed changes to policies on cultural heritage and sustainable development in the Cities of Aswan and Nuweiba in Egypt **(ICS-1). Kolakowski's** research with EMESS on traditional 15th Century Mud and Stud housing construction in Lincolnshire has led to a comprehensive survey of 88 houses in the region, together with monitoring of environmental conditions in twelve traditional houses.

1.5. Research and Impact Strategy for the next 5 years

During the next REF cycle, the UoA will continue to advance the University's research and impact strategy following the principles of producing "purposeful research with impact" and contributing to research that has relevance and significance both locally and globally as per the examples below. We will continue prioritising interdisciplinary research with the potential to enhance the broader environment and culture of our region (see Institutional Environment Statement), (Section 1.2(5) and 1.3). We will achieve these under the umbrella of the Sustainable Built Environment Research Group (SBERG), a group aiming to increase the academic rigour and relevance of our research and translate it into practice with impact, and enhance the quality of narrative and the depth of cooperation within the School, College, University and beyond.

Our future research strategy will:
1. Continue to build on our established expertise in building energy assessment, and to develop further the UoA's strength in new building typologies including housing for an ageing population (**Sodagar, Pretlove, Elnokaly** and **Zhao**) and heritage, eco-cities and sustainable development (**Byrd**, **Elnokaly, Sodagar** and **Pretlove**). We will exploit our expertise in the potential of low carbon construction materials and techniques led by **Kolakowski** to extend our network of partners in the UK and Europe (see Section 4.1). We will also expand into the area of sustainable and zero waste construction practice, an area **Sarhan, Elnokaly, Sodagar** and **Pretlove** are working on.

2. Widen our international collaborations. This will be achieved by drawing on our growing international research collaborations and networks as well through visiting research programmes (Section 1.2(7)). We will also widen our geographical outreach by conducting research individually and collectively in New Zealand (**Byrd**), China (**Zhao**), the Middle East, North Africa and Nigeria (**Elnokaly**)**,** and Europe (**Sodagar, Pretlove, Elnokaly, Kolakowski** and **Sarhan**).

3. Expand our Interdisciplinary research and increase external research income, by leveraging our current international, national and regional collaborations, while increasing alignment with emerging funding opportunities. We will focus in particular on expanding our research capacities in our newly-established areas of CSM and AST (see section 1.1). Existing collaborations with other schools in the University will be prioritised and we will further develop our collaborations through the work of Lincoln Institute for Advanced Studies (LIAS) and the newly-inaugurated LinCEJ. Our ambition is to grow external income to at least half a million pounds per annum. We will achieve this by targeting UKRI, British Council, British Academy, Innovate UK, Charitable organisations and EU funding opportunities.

4.Maintain Impact as a central focus of importance. Providing support to colleagues seeking to enhance the impact of their research is part of our career development policy for UoA staff, offered by the School Director of Research (SDoR) and the School Impact Lead. The School Impact Lead will continue to draw on the support provided by the University, College and the School to encourage and mentor staff to develop and document the impact of their research. Regular impact away days will be arranged for staff to focus on impact planning, and bespoke training sessions will be organised. The current Post Occupancy Evaluation (POE) and KTP projects of **Pretlove**, **Sodagar, Elnokaly** and **Zhao**, provide obvious starting points for growing collaborations with industrial partners. Similarly, **Elnokaly's** work through funded interdisciplinary projects on Eco-Cities and Heritage with international partners will provide a platform to grow the impact of our research beyond the UK. **Pretlove** and **Sarhan** will build upon their recent funding success (Point 1.2 (3)) to expand their work with industry, in particular seeking to identify other stakeholders who can benefit from their work. They will run focus groups and post-project workshops with representatives from the Building and Civil Engineering Charitable Trust, Health and Safety Executive, and key local contractors and construction industry stakeholders to develop opportunities for further research. **Kolakowski** will expand his work on potential and application of low carbon construction techniques to national and European levels through the networks he has already established in the UK and Europe (See

section 4.1). **Byrd**'s work on climate change, now augmented through the leverage of the UN, offers a potential platform for us to have an impact at the global level.

5. Augment the UoA's PhD completions to at least ten in the next census period. PhD numbers will be increased through furthering our interdisciplinary collaboration within the University centres and beyond via joint-supervision. We are currently receiving high numbers of PhD applications on the new CSM route that will contribute to increasing the number of PhD students in our UoA. (Section 1.3).

1.6 Progress towards Open Research Environment

Our UoA is fully committed to the open-access policy. The University is a signatory to the San Francisco Declaration on Research Assessment (see Institutional Environment Statement for the University's policies and procedures, including the Open Data Working Group). All outputs submitted as part of this submission are lodged on the University's Repository, which offers all staff a site for open publication complying with the demand of green open access as specified by HEFCE. Staff are supported by a dedicated member of the R&E team, and regular training and advice sessions are provided to ensure that research outputs are freely available as soon as they meet the criteria. PGR students also receive training from the Doctoral School in the requirements and opportunities of open access and the University's PhD theses are freely available online.

1.7 Research integrity

The UoA approach to research integrity is governed by the Concordat to Support Research Integrity and the University's Code of Practice for Research (see IES). Research in the UoA is conducted according to the principles of integrity, academic excellence, accountability, inclusiveness and professionalism. The University instituted a new online ethical approval procedure in 2018, which provides efficient, supportive centralised review and monitoring of ethics applications, overseen by the University's Research Ethics Committee. All research projects undertaken by the UoA's staff or its PGR students must complete a Project Registration Form that is submitted to and reviewed by the CoA Ethics Committee. The UoA Staff and students receive advice and support from an Ethics Champion **(Kolakowski)** who sits on the College Ethics Committee and supports the review of ethics proposals, and also from **Elnokaly,** appointed as the new CoA Ethics Lead (and Chair of the College Ethics Committee (Jan.2021). The SDoR, CoA Ethics Lead and the R&E team ensure that all grant applications from staff comply with the University Code of Practice for Research and Research Ethics Policy and the principles laid out in other relevant policies, guidelines and codes of conduct, including those of funding bodies such as the Research Councils. PGR students and their supervisors review the ethical aspects of students' research every year as part of the annual monitoring review. Staff have access to training in issues connected to research ethics and misconduct, which is governed by the University's application of the UKRIO Procedure for the Investigation of Misconduct of Research.

2. People

2.1 Staffing Development and Strategy

The UoA's staffing strategy in recent years has geared towards strengthening interdisciplinary research focussed on areas associated with the integrated Built Environment. To achieve this the School invested in expanding its research in CSM by appointing a Professor of Sustainable Construction in 2017 **(Pretlove)** who was tasked to expand the Unit's research in Construction and Architectural Technology. Subsequently, **Sarhan** was appointed in 2017 as a Lecturer in Construction Management to further support research in that field. This led to a growth in interdisciplinary research between UoA staff such as **Pretlove, Elnokaly** and **Sarhan**. **Zhao** was appointed as a lecturer in Architecture in 2018 to contribute to research in the built environment. The UoA is fully committed to the provisions of the Concordat to Support the Career Development of Researchers (see IES). This commitment is demonstrated by the case of

Elnokaly who was promoted to the role of Associate Professor in 2015 evidencing the University's and the UoA's commitment to succession planning and to developing new leaders in built environment research. Staff are supported in developing their career progression through an annual process of probation (in their first year) or appraisal (in subsequent years) that aids them in setting goals and identifying the resources they need. All staff develop an annual Individual Research Plan (IRP), where they reflect on research and impact activities in the previous year and plan for the year ahead. This is reviewed in a one-to-one mentoring meeting with the School DoR. The IRP process feeds into annual Academic Appraisal (ADA), so that research and impact activities can be considered in setting staff objectives for the next year and may inform workload planning. For example, as part of the IRP mentoring process, **Sodagar** and **Byrd** mentored **Zhao** in 2019 in producing her 2020 paper in *Energy Research & Social Science*. All academic staff are entitled to one day a week to spend on research and impact activities and research leave can be allocated for completing tasks such as outputs for publication.

Further support for targeting funding resources and developing funding applications is available through the University Research and Enterprise team. The College, through the Research Resources Allocation Fund (RRAF) covers costs for staff wishing to present their work at conferences. RRAF also provides funding for fieldwork and for the purchase of research equipment. For example, **Zhao** was awarded funding in 2019 to purchase the 'Meteornorm' software for her International collaborative research (See Section 3.1 for outcomes). During the census period, UoA staff submitted 19 successful applications to RRAF securing a total funded sum of £15,800.

2.2. Support for PGR Students

In this census period, the UoA increased its number of PGR completions from 0 to 5, with registrations rising from three at the census date in 2013 to six in 2020. This was achieved by developing a comprehensive programme of support for PGR students at School, College and University level. The University level support is described in the Institutional Environment Statement. At College level, there are regular training events, a minimum of six per year, providing induction, training in research skills and preparation for giving research papers and for the viva.

The RRAF (see section 2.1) also offers ring-fenced support for PGR students. During the cycle students associated with the UoA have secured £4,000 to support PGR students in conference attendance and publishing outputs (four in 2016/2017, two in 2017/2018, three in 2018/2019 and one in 2020). Five of our PGR students received Santander funding (£500 each) for research travel.

Our commitment to interdisciplinary research extends to our PGR students: **Elnokaly** has two PhD students that she jointly supervises within the School of Mathematics and Physics; two more University-sponsored PhD studentships were secured jointly with the School of Engineering (2017-20). This enables architecture PGR students to benefit from the disciplinary insights, expertise and research facilities available across the University.

All PGR students are supported and mentored in presenting their work at the annual Research Indaba conference (section 2.1). Ahmadian presented papers in three consecutive years (2017-2019) which were subsequently converted into three published research articles in 2018 and 2019. AlQadi's presentation in 2017 resulted in a journal publication in 2018. Namvar presented her work in three consecutive years and later produced a conference publication. Anele presented her work twice and Dogonyaro presented his work in 2019; each has resulted in a journal publication. International PGR presentations have included Ahmadian at the CISBAT 2019 conference, in Lausanne, Switzerland and the 8th Global Conference on Global Warming (GCGW), Doha, Qatar (Apr 2019) facilitated through the financial support provided by the College, and Aly at Building Simulation Optimisation (BSO 2018) International conference, the Passive and Low Energy Architecture (PLEA) 2017 and the Researcher Links Workshops (Turkey, Thailand, Egypt).

2.3. Equality, Diversity and Inclusion

The Unit's approach to Equality, Diversity and Inclusion (EDI) is based on the Institution's One Community ethos (see Institutional Environment Statement). The School of Architecture and the Built Environment works closely with the Eleanor Glanville Centre (EGC), the Institution's central department for diversity and inclusion. The UoA adheres to institution's EDI principles to create an inclusive research environment in the School. The governance and promotion of EDI in the UoA are monitored and reported to the College-level EDI Committee, which in turn reports to the University Inclusion Committee. **Elnokaly** sits on the University Race Equality Committee representing the CoA and the LSABE. All staff at the school have attended mandatory EDI training on matters such as unconscious bias and EDI in Practice, with training on other issues available as described in the Institutional Environment Statement. Further training is mandated for reviewers and those in mentorship and leadership positions to promote inclusivity in decision-making. PGR students receive similar training and advice as part of their induction, and PhD supervisors, and transfer panel and viva chairs are required to keep this training up to date. Further specific EDI training was provided to all staff involved in producing the Architecture REF submission. Selection of staff outputs was subject to a rigorous process with an internal panel and independent chair from outside the College. Staff were actively encouraged to declare individual circumstances with bearing on their research via a confidential procedure.

The UoA has a strong record of gender equality and racial diversity and inclusion and is home to a diverse community of staff from countries such as Poland, Egypt, Iran, China, New Zealand and the UK, reflecting its ambition to internationalise its profile. In the academic year, 2017/18 the ratio of female staff to male staff was just short of 40%. The Unit has made progress towards gender equality and promoting the Built Environment courses among women, with 60% of PGR students female. The Unit has also made good progress on racial inclusion; all of our PGR students come from diverse racial and ethnic backgrounds. It has been actively engaged with the University and external bodies to promote EDI. For example, a key development in the census period has been the LSABE's achievement of the Bronze Award as part of the Athena SWAN Charter in 2019. The Architecture and the Built Environment Athena SWAN Working Group was established in 2015 with six members (five staff and a PGR student). To promote good practice, the committee has a female chair and male vice-chair who rotate. In addition, the School has an internal EDI committee which includes four members of staff that are part of this UoA (**Pretlove, Elnokaly, Kolakowski and Zhao**). Outside this, all committees have male and female representation and 30% (2 out of 6) of the School Leadership Team are women.

The UoA is committed to advancing women's research careers in STEM subjects, **Elnokaly** is part of the University Committee of WiseLincoln (Women in Science and Technology). To celebrate International Women's Day in 2018, we held a one-day workshop in collaboration with the Royal Institute of British Architects East Midlands (RIBA EM) regional office recognising the contribution of Women in Research and Architecture. The event proved to be very useful to the audience for gaining insight and advice on equality and diversity within the profession. In October 2019, **Elnokaly** was invited to attend as a panellist for the 'Women in Architecture' event held in Nottingham that was developed by RIBA EM and the University of Nottingham. All of our research facilities and support are equally accessible for everyone within our UoA, regardless of their age, gender, race, religion, ability and sexual orientation.

3. Income, infrastructure and facilities

3.1. Strategies for generating research income, and research infrastructure and facilities

The School provides mentoring on income generation to ECRs; subscription to 'Research Research' is provided, and the Research and Enterprise Office regularly sends targeted notices of pertinent grants.

The University Library (see Institutional Environment Statement) provides access to more 105,000 full-text journal titles and around 500,000 eBooks, as well as specialist databases, including *Art and Architecture Complete*, *Avery Index to Architectural Periodicals*, *Construction Information Service*, *Digimap* and *Detail Inspiration*. Staff and PGR students benefit from unlimited inter-library loans and can recommend books that they would like the Library to purchase through the 'More Books' Patron-Driven Acquisition.

Support for research activities such as field trips and conference attendance nationally and internationally, is available through RRAF (see Section 2.1) to which applications can be made three times a year. These grants have facilitated staff attendance at national and international conferences and supported the purchase of research tools and equipment (Sections 2.1 & 2.2). For example, **Sarhan** was awarded RRAF funding in 2018 for a joint conference paper with **(Elnokaly** and **Pretlove)** that was selected for a plenary session at the 26th Annual Conference of the International Group for Lean Construction. This qualified the paper for publication in the *Lean Construction Journal* where a developed and improved version appeared in 2019. Consequently, **Pretlove** and **Sarhan** were guest editors for a special issue of *Construction Economics and Building* on 'Lean and Sustainable Construction: State of the Art and Future Directions', to be published in September 2021.

Research within the School is overseen by the School Research Committee, which is chaired by the School DoR and PGR lead for Architecture **(Sodagar)** and includes HoS **(Pretlove)**, Deputy Head of School, UoA coordinator and Impact lead **(Elnokaly),** and PGR lead for the Built Environment **(Sarhan).**

Researchers are encouraged to use small grant schemes to seed larger projects. For example, **Sodagar's** initial ESIF Innovation Voucher led to his successful KTP with Floor and Wall Ltd. (Section 1.2(4))**.** As part of her IRP review, **Zhao** was identified as needing support with an international collaborative research project with researchers at the Lingnan Normal University in China. She secured RRAF funding from the college to purchase the 'Meteornorm' software that resulted in a study on effects of landscape patterns on the summer microclimate and human comfort in urban squares (currently in progress). The early findings from this research promise to provide design guidance for the landscape configuration of urban squares in similar climates. **Kolakowski** secured a £5000 ESIF Innovation Voucher to research Natural Architecture in collaboration with local company Millstone Restoration and is currently in discussion for developing this into another larger funding application. Following an ESIF Innovation Voucher (£5000), **Pretlove** is currently in discussion with a housing association, a provider of private and social housing, to submit a KTP application to investigate the potential of low energy affordable homes.

Our research income strategy for the next five years is to continue supporting staff in applying for research bids and research funding opportunities through continuous mentoring and use of support mechanisms available within the School, College and university as discussed above. In addition, at the College level, away days have provided workshops on writing bids with experienced mentors available to guide those making their first bidding attempt. We will further oversee the development of new income opportunities through securing at least another three KTP projects with the building and construction industry.

4. Collaboration and contribution to the research base, economy and society

4.1 Research Collaborations, networks and partnerships

Members of the UoA are part of a range of interdisciplinary networks stretching beyond Lincoln, and HE, examples of which have been given in previous sections of this statement. These networks are integral to the research, impact and outputs of the UoA and relate both to its established areas of expertise in the broad context of sustainability and sustainable built environment, and new and emerging areas of Construction Science and Management. **Pretlove** was appointed in January 2021 (for a period of three years initially) as an Honorary Research

Associate at Durban University of Technology to assist the institution to develop its research plan and provide research support to staff. **Elnokaly** has worked on a series of research programmes with other international institutions including various HE institutions in Egypt, Thailand, Nigeria and Algeria. One example of this is the research project "Energy-efficient building envelope for low-income housing" conducted with a Professor from the British University in Egypt. This attracted a British Council Researchers' Link Travel Grant of £25,000 in 2015, to carry out an empirical comparative study of different thermal walls created from recyclable materials. **Byrd's** initiation of international collaboration at the UN-Habitat III led to the UoA's inclusion in Habitat UNI's *Big Blue Book*, that maps and showcases international Urban Studies research. **Kolakowski** has worked with a network of academic and industry partners from the UK and beyond including Earth Building UK and Ireland; Straw Building UK; East Midlands Earth Structure Society; Earth Hand and Houses and Europe: OSBN, the Polish Natural Building Organization; European Straw Building Association and Cohabitat Foundation (Poland) to research the potential of low carbon building materials and solutions. **Kolakowski's** collaboration with industry led to the joint research work on Hexagonium and collaboration with East Midlands Earth Structure Society resulted in collaborative research via an ESIF Innovation Voucher with Millstone Restoration. As a result, a prototype of a new prefabricated natural construction panel has been developed. **Pretlove** and **Sarhan** are collaborating with BAM Construct UK as industrial partners in research into developing Construction Supply-Chain Management Standards (CSCMS) for Improving Occupational Stress management and Productivity in Construction Projects.

Organising Interdisciplinary Research Workshops Nationally and Internationally.
Elnokaly organised and chaired the International Workshop on Cultural Heritage and Livelihood of Bedouins of South Sinai, in Collaboration with Ainshams University, Egypt in Nuweiba, 20-28 October 2017, where she presented to members of the community, government representatives and NGOs. **Kolakowski,** in collaboration with the East Midlands Earth Structures Society, organised a series of workshops between 2012 and 2017 to develop proposals for the construction of a contemporary Mud and Stud house. His other collaborations include Clayfest, a workshop and exhibition (organised in conjunction with Earth Building UK, Ireland and Lincolnshire Heritage Skills Centre) to promote natural building techniques in June 2017. **Elnokaly** organised and chaired the International Workshop on 'Rebuilding Communities for Resilient and Sustainable development: Eco-Cities', in collaboration with Cairo University in Aswan Egypt (December 2015) where she addressed member of the community and key stakeholders. **Elnokaly** organised and chaired one-day Symposium 'Lincoln Cathedral and Architectural Theory' in January 2015. **Kolakowski** worked with Earth, Hands and Houses, an organization promoting natural construction, and its founder Paulina Wojciechowska, in a workshop on earth plastering. **Elnokaly** is the co-founder of the Energy, Environment and Sustainability Interdisciplinary research group at the UoL. As part of this she organised two interdisciplinary research symposiums on Energy, Sustainability and Environment at the University bringing together colleagues from various disciplines with interests in any related Africa Studies.

4.2 Relationships with users, beneficiaries and society

Beneficiaries
Through our impact strategy (Section 1.5), we have formed various past and current interactions with industry. Examples include **Byrd**'s work on Christchurch with government agencies, policymakers and planners that helped with the rebuilding of Christchurch following its earthquake. **Kolakowski** worked with a range of actors and stakeholders on the development of the potential and uptake of Natural Architecture. **Elnokaly** has worked as a consultant to Sigma Properties (a Leading Heritage Property developer) in Alexandria, Egypt since 2015 where she advised their heritage property management section on projects reutilizing heritage buildings to turn them into key pieces of urban infrastructure. Elnokaly also consulted and supported the research work undertaken at Habiba Community Farm in Nuweiba since October 2017. **Sarhan** has worked with a range of construction companies to inform and assist them with adopting a lean design approach in their construction projects. **Pretlove** is supporting the Durban University

of Technology in South Africa in the identification and implementation of research strategies and activities.

Audience
Members of the UoA have engaged with a range of public audiences, through the media and public lectures. **Byrd** was invited to talk on Radio NZ about his research in 2014 titled "New research predicts more power blackouts across the world". Between 2017-2019, **Elnokaly** was featured in over 15 interviews across in Egyptian TV channels talking about Egypt's sustainable agenda 2030; the role played by Social Governance on Sustainable development in Egypt; revitalisation of cultural heritage in heritage city centres of Egypt and lessons learnt from international best practice of sustainable development projects. In July 2017 Elnokaly featured on Egyptian TV talking about her journey in research and HE and her experience as a leading women in (STEM). In 2018, she was interviewed by Radio Lincolnshire FM to talk about her international award and her work on cultural heritage and sustainable development in Egypt'.

Wider Contributions to the research base
Members of the UoA have made major contributions to committees and advisory boards at national and international levels examples of which include:

Peer review for research councils and research funding bodies
Staff in the UoA contribute to peer review for research councils and research funding bodies, for example, **Sodaga**r is a grant reviewer for funding applications submitted to EPSRC; **Byrd** was appointed reviewer in 2014 for the Royal Society of New Zealand, he is also a reviewer for applications submitted to the Marsden Fund, NZ; **Elnokaly** acts as an assessor and reviewer for Newton Fund/Science Research Programme for the British Council 2018-2021; **Pretlove** was a research application assessor for the UK Government's Technology Strategy Board's (now Innovation UK): Energy Catalyst (2014), Integrated Supply Chains for Energy Systems (2015), Energy Game Changer (2016), and Women in Innovation (2016) competitions.

Board Membership of professional bodies
Members of the UoA contribute to Board Membership of professional bodies, for example, **Elnokaly** is Member (2012-date) of the RIBA East Midlands Regional Council Board and a member of its East Midlands Education Committee. She is also a board member (2010-Date) of IBPSA-England: International Building Performance Simulation Association. **Pretlove** was a member of the Sustainable & Low Energy Architecture Technical Committee for the World Renewable Energy Network (WREN) (2014- 2016); and is a Built Environment Expert for the Design Council/CABE since 2014

Journal Editorial Board Membership and Peer Reviewing:
All staff in the UoA take an active role in sustaining the discipline. In the census period, they have served on seven editorial boards including *International Journal of Architectural Research* (Emerald Group Publishing)*; Civil Engineering and Architecture* (Horizon Research Publishing); *Journal of Renewable and Sustainable Energy* (Science & Education Publishing, USA); *Sustainability; Buildings* (both MDPI); *Building Survey, Appraisal & Valuation* (Henry Stewart Publications). In addition, members of the UoA have reviewed manuscripts for over 25 journals including *Energy; Energy and Buildings, Environmental Impact Assessment Review; Frontiers of Architectural Research; Building and Environment; Habitat International; Cities* and *Energy Policy* (All Elsevier); *Journal of Building Performance Simulation* and *Journal of Architectural Engineering and Design Management* (Taylor and Francis); *World Journal of Science, Technology and Sustainable Development* and the *International Journal of Managing Projects in Business*; (Emerald Publishing).

Invited Keynote Speakers:
The outreach of research from this UoA is exemplified via several invited keynotes during the census period. These include **Byrd** (invited speaker 'Infinite Suburbia', Centre for Advanced Urbanism, Massachusetts Institute of Technology, 2016; keynote speaker at the conference Challenges of Extended Mega Urban Regions, 19-21 November, Putrajaya, Malaysia 2013).

Elnokaly (keynote speaker at the World Youth Forum 2017 and 2019 on 'the Role of Civil Society in Implementing the UN SDG's attended by over 5000 people from 144 countries, Egypt; keynote speaker at the International Conference of Health and Wellbeing, Beirut, Lebanon (October 2018); an honouree participant and speaker 'Egypt Can' conference (July 2017); Chair of the PhD forum (Nov. 2014) at the UN-Habitat 6th International Conference on Informal Communities (November 2014); invited speaker 'the Women's Growth and Success Forum' discussing 'Women entrepreneurs and experts from Arab countries and Europe') (May 2014).

PhD External Examiners:
Members of the UoA have acted as PhD external examiners at different universities nationally and internationally including **Sodagar:** Nottingham University (2016), University of South Australia (2016). **Elnokaly:** University of Nottingham (2017, 2018, 2019), University of Wolverhampton (2015 & 2016), the University of Salford (2018), Strathclyde University (2018), Cardiff University (2018 and 2020), Cairo University, Egypt (2016), Alexandria University, Egypt (2017 and 2020) and the Federal University of Technology, Nigeria (2015 and 2017) and Curtin University, Australia (2020). **Byrd:** University of Adelaide (2017, 2020), Universiti Sains Malaysia (2016), and Victoria University of Wellington (2015).

Awards:
Members of the UoA have received several awards for their contribution to research and development during this census period. For example, **Byrd**'s design of Waiheke Island Library, a zero-energy building, won the top award in the Commercial Architectural Excellence Category and the Overall Supreme Award the New Zealand Timber Awards in 2015. In 2019, **Elnokaly** received an Honouree Award from Sigma Properties in Egypt for her contribution to developing a regeneration framework for heritage buildings in Alexandria and to culture heritage projects. In 2017, she received Egypt's **President's Award** for Pertinent Expatriates of Egypt Abroad. She received an honouree Award of **"Egypt Can 2017"** by the Ministry of Expatriates in recognition of the work done to support Egypt's Sustainable development and in shaping the strategy of Sustainable Development 2030 in Egypt.