Article:
Clarke, BG, Middleton, C and Rogers, C (2016) The Future of Geotechnical and Structural Engineering Research. Proceedings of the Institution of Civil Engineers - Civil Engineering, 169 (1). ISSN 0965-089X

https://doi.org/10.1680/jcien.15.00029

Table 1 Social and economic infrastructure sectors and the significant eras of development of current infrastructure to highlight the longevity of construction output and the need to adapt to cater for changes in technology, regulations, environment and demand

Social Infrastructure (post 1950)	Economic Infrastructure
Housing	Road (Roman, Turnpikes)
Healthcare	Drainage (16th C)
Leisure	Defences (coast, waterways (17th C)
Sport	Ports (17th C)
Government	Rail (19th C)
Retail	Water (19th C)
Offices	Waste (solid, liquid) (19th C)
Manufacturing	Energy (gas, electricity, heat) (post 1950)
Emergency services	National strategic highways (post 1950)
Education	Air (post 1950)
	Communications (late 20th C)

Table 2 The 2014 UK Infrastructure pipeline, by sector, 2014-15 onwards (after IUK, 2014)

Sector	No of Projects[1]	No of Programmes[2]	Pipeline Value (£ bn)
Communications	1	5	11.0
Energy	77	70	274.9
Flood	5	21	3.7
Science and Research	18	4	1.4
Transport	141	129	142.3
Waste	20	0	2.0
Water	1	59	30.9
Total	**263**	**288**	**466**

1. Projects fund an activity in one of the strategic research themes
2. Programme Grants provide flexible funding to support a variety of activities focussing on one strategic research theme.

Table 3 Suggested research themes and topics

Theme	Topic
Hazards	• Database of the impact of catastrophic events on the built environment and the response, recovery and rebuild phases • Interpretation of that database to establish key lessons • Scenario analyses to assess impact of future events to existing built environment and relevance of codes • Understand the effect of cascading failures • Identify emerging risks because of developments in technology and their impact on the built environment • Understand the impact of the planetary boundaries on the built environment
Understanding material behaviour	• Intrinsic properties of new materials • Performance of materials in situ • Capacity of materials in situ throughout life
Paradigm Shift in Design	• Assessing the value of infrastructure • Identify appropriate performance indicators that take a holistic view of the lifetime of a design

	• Identify failure characteristics, pre failure and the characteristics of the probability of failure • Create a life quality index to be used in design • Create a process to assess future design requirements to allow existing designs to be validated against those criteria • Establish the emerging design approaches and their impact on the built environment
Construction processes	• 3D printing of complex shapes to facilitate assembly and reduce resources • Optimisation of structural elements • Methods of assembly • Structural form
Building performance	• Development of instrumentation to reliably monitor the behaviour of structures including load distribution, capacity and function • Database of structural performance • Interpretation of that database to improve numerical models and future design
Smart Buildings	• Development of autogenous materials and elements • Multi functioning structural elements to make full use of intrinsic properties • Identify value of structures, their capacity and life
Asset Management	• Identify the value of the built environment and how it can be valued • Means of identifying client requirement • Decision making criteria • Retain national memory of construction processes and material performance • Development of diagnostic tools and data acquisition techniques • Predicting capacity and capability throughout life
Intervention	• Development of early warning systems to predict failure • Optimisation of planned interventions • Diagnostic tools to assess impact of interventions • Development of imaging techniques
Decarbonisation	• Introduce energy, water and carbon as design criteria • Multi functioning structures • Refurbishment to minimise carbon emissions
Adaption	• Design for adaptation • Understanding the relationship between over engineering, optimisation and future use