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Standing on ye Shoulders of Giants: promoting a social systems engineering education using ICE President Addresses (1820 - 2014)

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Abstract

Given the paucity of engineering history presently taught on civil engineering programmes, the purpose of this paper is to promote the role of historical testimonies for the delivery of an enhanced, contemporary and social systems educational experience. Drawing on the addresses of the presidents of the Institution of Civil Engineers (ICE) (1820–2014) as a source of inspiration and motivation, civil engineering students (n=428) were required to select and read six inaugural addresses of former ICE presidents and use these as a catalyst for writing their own 'ICE presidential address' while keeping an eye forwards to the year 2050.The results reveal that the ICE presidential addresses help introduce undergraduates to the real and 'human' world of civil engineering and provide the students with a 'social', as opposed to a scientific, understanding of their profession. Exploring and exploiting the substantial depository of knowledge, values, wisdom and social context of ICE presidential addresses are both innovative and novel and worthy of adoption and adaptation by other academies seeking to prepare civil engineering undergraduates as global citizens.

Keywords: History, Social Impact, Education, Holistic Engineering

1. Introduction

It is common for civil engineering students to enrol at university with a relatively narrow understanding of their chosen career path. The provision of scholarly research and writing activities in connection with the history of an engineering

society (e.g. the UK Institution of Civil Engineers (ICE)) can help develop a student's anticipatory socialisation in to the civil engineering profession. Such scholarly activities provide an opportunity for first-year students to 'take on the mantle of independent learning from the word go' (Moir 2011, p.4) and encourage them 'to develop their academic, personal and professional potential' (Quality Assurance Agency 2005, p.4).

While the concept of anticipatory socialisation is routinely overlooked as a prescribed teaching objective, its contribution to student maturity is acknowledged by Morley (1994 p.424) who argued that 'knowledge of the history of the profession and its accomplishments can serve to socialise the student into the profession by instilling a sense of shared past and shared culture'. Moreover, the Joint Board of Moderators (JBM), the organisation responsible for accrediting civil engineering courses in the UK (under licence from the UK Engineering Council) believes that:

> Universities should encourage students to take up membership of a professional organisation, have an understanding of the rules of conduct and play an active role in membership through extracurricular activities such as CPD events, committee involvement, visits to the Headquarters Library, etc. (JBM 2009, p.1)

Undergraduates in the U.K who register with the ICE as student members join a long-standing organisation first formed in 1818 and with a current global community of over 86,000 members, representing 150 countries (ICE, 2016). To help inspire a universal social and cultural capital among its members, diverse communities can coalesce around its pioneers, shared history and testimonies that accompany ICE membership to learn, reflect and contribute responsibly to an increasingly interconnected and international society.

As with other professional institutions, the catalogue of ICE's presidential addresses provides a concise and easily accessible body of knowledge. As cultural artefacts, they offer the curious reader a depository of intriguing personal perspectives and anecdotes charting the history of the civil engineering profession spanning three

centuries. These types of ‘documents are important for research because they are authentic survivals of the past’ (Reingold 1987, p.31) and through a process of considered reflection, undergraduates, and indeed the practising civil engineer, may learn of past and contemporary engineering customs and practice.

In relation to the title of the paper and Newton’s letter sent to Robert Hooke in 1676 containing the iconic aphorism “If I have seen further, it is by standing on ye shoulders of giants” (Historical Society of Pennsylvania 2012) it is necessary to make the reader aware that it is a common misconception that the phrase was an original observation by Sir Isaac Newton. Howard (1999 p.65-66) presents a discussion investigating the origins and change of meaning of the aphorism that is thought to originate from the twelfth century and translated from Latin to English by a twentieth century scholar. The original text is understood to have read, ‘in comparison with the ancients, we stand like dwarfs on the shoulders of giants.’ First-year students may perhaps consider themselves to be engineers in training as opposed to ‘dwarfs’ but the analogy of being a mentee, learning from more experienced engineers (see Murray et al 2015) who may ‘have the time, perhaps the wisdom, hopefully the energy to help the younger members to chart the way forward’ (Ridley 1995 p.13) is appropriate. Indeed, the ICE addresses offer an early opportunity for students in transition to university to engage with their professional community of practice:

> ……from the first day that students enrol on an accredited programme of study they have commenced on their career as a professional engineer. (JBM 2009, p.1)

Drawing on the ICE presidential addresses as a source of inspiration and motivation, this paper presents a longitudinal study (2010-2015) of a novel first-year civil engineering coursework. The student’s ‘role-play’ in writing their ICE president address is drawn upon as the primary unit of analysis. The coursework forms part of a wider initiative entitled ‘reading for your degree’ and was conceived and developed by the lead author at the University of Strathclyde (herewith Strathclyde). Additional curricular and co-curricular activities include a civil engineering book reading

coursework and associated book club (UOS 2016). Other blended learning assessment requires students to consult the weekly *New Civil Engineer* (Murray and Tennant 2014) and the promotion of more general reading including the *National Geographic* magazine (Murray and Ross 2014).

Encouraging the students to 'read' (particularly off-piste module reading lists) rather than to rely on being taught facts tends to challenge their epistemological preference for codified 'vocational' knowledge. As engineering students in transition to university the requirement to read can equate to a 'shock and awe' experience. However, with instructional scaffolding (a link to employability knowledge and displaying a personal enthusiasm and joy for learning for its own sake) reading can lay the foundations for a culture of intellectual engagement, intrinsic motivation and curiosity amongst the student populace. Moreover, an appropriate blend of vocational and liberal education can promote a holistic engineering learning experience, connect civil engineering with wider social systems and prepare students as global citizens.

2. Civil engineering history in the curriculum

The study of civil engineering history appears to be a topic that attracts periodic interest from a relatively small community within academia and industry. While the formal study of civil engineering history remains uncommon, several ICE presidents have made comment. William Cubitt (1850, 142) the fifth president reminded members of their duty to deposit records of their works so as to aid the work of 'future historians of this eventful age'. The 33rd president Benjamin Baker (1896, 7) commented that 'a backward glance thus may afford some useful hints and lessons as to the future'.The 117th president (Campbell 1982, 6) spoke of the need for civil engineering managers to have 'a basic knowledge of history and geography ….to appreciate how the events of today related to the evolution of the past'. And while Reeve (1986) the 121st president disagreed with the idea of flirting with nostalgia, the 136th president Joseph Dwyer (2000 p.2) believed that 'in celebrating our history we should seek to learn valuable lessons from that history and apply them in a modern context'. Despite occasional presidential indifference, according to Chrimes (2004b,

p.142) the benefits of historical research, particularly, studying the lives of past generations of civil engineers '*en masse* increases our understanding of the development of the profession'. Furthermore, Goldberg and Somerville (2014 p.131) argue that engineering students should be encouraged to experience the 'joy' of engineering and that 'celebrating engineering heroes and telling iconic stories' can contribute to this goal.

In response to the question ('why teach history to engineers?') set by Jarvis (2001) in the title of his paper, he concluded that historians can 'ease the rite of passage from student to being an employee in coming to terms with the real world'. In 2002, the weekly magazine *New Civil Engineer* (NCE 2002) prompted a debate by asking- 'should engineering history be taught to undergraduates in specific compulsory modules'? While the debate only provided one argument for and against, both agreed that learning about the history of engineering can be exciting and help student engineers imagine the future.

A more extensive investigation (Swailes and Chrimes 2004) of UK civil engineering departments sought to identify ways in which the ICE Panel for Historical Engineering Works (PHEW) could facilitate this matter. Subsequent research proposed the creation of 'authoritative historical case studies for use in teaching subjects such as structures, hydraulics, geotechnics and management'. Private communications with one of the authors (Swailes 2015) confirmed that the case studies did not materialise. However, in the USA, a professor of civil engineering has authored a series of four papers (Griggs 1994;1996a;1996b;1999) adopting Isaac Newton's *'on the shoulders of giants'* and these are intended to encourage and aid academics to introduce the history of civil engineering into specialist subjects .

Given that the industrial revolution (circa 1760 – 1840) had a significant hand in shaping (and was shaped by) the development of the civil engineering profession, it is perhaps pertinent to mention the Newcomen Society. Founded in 1920 and named after Thomas Newcomen (1664-1729) who invented the first practical working steam engine, the Society promotes the study of engineering and technology history.

Former president of the Newcomen Society, Dr. Hamilton (1945, 7) presented a compelling argument for 'why engineers should study history':

> "No man is really civilized or adult in mind until he comes to realize that the past, the present and the future are one and indivisible. To live and think only in the present, to ignore the past and disregard the claim of the future is to remain infantile and barbarian."

Hamilton's address, coming only five months after Victory in Europe day (VE-Day) in May 1945 may have some hidden (or indeed explicit) sentiments. Fast forward to 2016 and while few newly enrolled undergraduates will reflect upon their history studies at secondary school of relevance to their engineering degree, the ICE believe that:

> Engineering history illuminates the development of civilisation through the study of ideas and techniques of the past. Historic records and archives provide a rich resource of photographic and documentary evidence for engineers to understand and conserve the built environment and celebrate our civil engineering heritage. (ICE 2015a)

Introducing new students to the history and heritage of the ICE can be easily accomplished through a blended learning approach. This may include the reading of books (e.g. Ferguson and Chrimes (2011) *The Civil Engineers: The Story of the Institution of Civil Engineers and the People Who Made it*) and journal articles (e.g. Cossons's (2012) *Does the engineering heritage matter?*). The 'critique' of relevant television and radio documentaries is also appropriate. Inviting a local member of a relevant society (e.g. the ICE Panel for Historical Engineering Works (PHEW)) to deliver a guest presentation is also advisable. These class-based learning strategies can be supported with site visits to iconic structures (see Clark and Andrews 2010). This is particularly useful when local communities are celebrating the half century / centenary / bicentenary of landmark structures. In addition, close liaison with quasi-

governmental bodies responsible for protecting and promoting the nations historic built environment can also prove fruitful.

While 'utilitarian' accounts of engineering history are both educational and enjoyable, students should be encouraged to reflect upon 'the person'. Biographical works offer a 'personal' history of engineering failure and success. While it remains unlikely that Samuel Smiles' *Lives of Engineers* (a five-volume series of biographies of nineteenth century engineers republished in various formats since 1862) can be found on module reading lists in any UK university civil engineering department, it does offer a rich source of personal testimonies.

Smiles biographies include former ICE presidents (Thomas Telford, John Rennie and Robert Stephenson, and his father George, the first president of the Institution of Mechanical Engineers 1847-1848). Critics argued that 'the list of virtues displayed by Smiles' heroes eventually becomes rather predictable' (Dentith 1994, p.49) and that Smiles made the central figures of the books 'quasi-saintly' (Jarvis 1997, p.109). While idealising historical accounts may blur the boundary between fact and fiction, the respected author and professor of civil engineering, Henry Petroski (2004 p.413) argues that *Lives of Engineers* are 'captivating and invaluable biographies of engineers and histories of engineering'.

In addition to the *Lives of Engineers* (Smiles 2006 edit), undergraduates can also be directed towards more recent text such as Doran's (1999) *Eminent Civil Engineers, Their 20th Century Life and Times*, described by Parker (2009) as a 'rare exercise in civil engineering autobiography' and Weingardt's (2005) *Engineering Legends*, a collection of biographies of American civil engineers that challenges gender imbalance through the inclusion of three female engineers. Indeed, it would be worthy for practicing civil engineers from under-represented communities to consider disseminating their own life stories through autobiography and / or storytelling events in schools ,colleges and universities.

Historical narratives can be both informative and inspirational and the 135th President (Fleming 1999, p.26) suggested that 'we need to continue to identify

heroes in our profession so that the younger members can take inspiration from them'. However, students should be encouraged to read such texts through a 'revisionist' lens. This will help counter the tendency for public and media to readily accept and promote an archetypical representation of 'great-man history', whereby 'heroic' engineers are viewed through a 'romantic' tradition (Duffy 1994). A revisionist lens as opposed to a 'rose-tinted' lens has potential to uncover previously ignored or undisclosed knowledge. For example, Andersen's (2011, p.205) research examining the colonial connections and networks of British consulting engineers revealed that 'at least 13 of the 30 engineers who served as ICE Presidents between 1880-1914' had undertaken work in the Crown colonies. He pointed out that such assignments would often attract knighthoods for engineers who were perhaps seeking social as well as professional prestige through their engineering endeavours.

In recent times, Jenkins (2015) newspaper article, '*Why white male heroes have all become zeros',* refers to recent biographies claiming the French architect Le Corbusier was a militant fascist. Jenkins muses that this 'adds to the growing realisation that there are no great men left'. Although some may feel a growing despondency at the apparent demise of 'engineering giants', it reinforces the notion of engineers as everyday people reaching extraordinary professional heights. A revisionist lens will encourage the student to explore and connect the person, their engineering legacy and private past with the present.

3. Why use the ICE Presidential Addresses?

> Every profession begins with its practitioners, and engineering is no exception. To understand the essence of this profession fully, we must understand its founders and pioneers, their intentions and their efforts, their achievements and their dreams. (Petroski 2005, p.xi)

In his inaugural address, Joseph Bazalgette (1884, 2) the 24th president of the ICE spoke of his predecessors being 'pioneers of some of the greatest achievements which have been attained in practical science' and that their names would be 'impressed upon the memory of future generations'. Given the esteem with which

many of the ICE past presidents are held, it can be concluded that there would be value in reading their inaugural addresses. Indeed, several presidents have made reference to the utility of the ICE addresses as a body of knowledge.

For example, Inglis (1908, 3) the 45th president considered them to be a 'concise history of the progress of the profession as viewed from the standpoint of successive presidents'. The 99th president Harold Harding (1964, 1) thought that they 'can lie between the extremes of the completely impersonal and the egotistical'. The 102nd president Ralph Freeman (1967, 2) found that the addresses 'make fascinating reading' and the 141st president Gordon Masterton (2005, 56) considered them 'an invaluable tool to help understand the past'. The 148th president Professor Barry Clarke (2012. 3) considered them to be a 'living history'. This provides reassurance, but an eminent nineteenth-century president throws a 'metaphorical' spanner in the works!

> In the early days of the Institution, when technical literature was non-existent, a presidential address constituted a valuable medium for disseminating useful knowledge, and for that reason it was not only listened to, but read by engineers…..**.** At the end of the nineteenth century the conditions are, however, vastly different…. presidential addresses are, therefore, out-of-date productions which no one reads, though many are still written. (Baker 1896, 2)

Baker (1896) makes a cautionary point and over a century later and despite the 35 UK professional engineering institutions (Engineering Council 2016) and a plethora of global engineering institutions and associations (World Federation of Engineering Organizations 2016) it is surprising that there remains a paucity of empirical evidence examining the inaugural addresses of their presidents, although Wynn (2009) investigated if the early ICE presidents recognised concepts of sustainability. This appears to reflect a wider industry perspective and only two studies were uncovered to help inform this research. Capshew (1986, 77) undertook a quantitative analysis of the addresses of presidents of the Society for the Psychological Study of Social Issues (SPSSI) and Lingard and Gale's (2010) research employed

presidential addresses of the Australian Association for Research in Education to undertake an analysis of issues pertaining to educational research.

According to Lingard and Gale (2010, 30), 'the presidential address is always delivered by individuals who may or may not embody the broad collective interests of the Association, or be representative of its membership, as a whole or in part'. The concern of 'ego' raised by Lingard and Gale (2010) and Harding (1964) is an important consideration for any researcher, particularly early year undergraduates who may be prone to accept too readily and without questioning, the narrative offered by each president. Nonetheless, viewed with caution through a revisionist lens, the transcripts of the addresses offer a rich insight in to the professional world of civil engineering and its incumbent technological, social, environmental and global impact.

At Strathclyde the students have a number of their own alumni giants in Alastair Craig Paterson (ICE President 1988-1989); Sir William Francis (ICE President 1987-1988); Emeritus Professor George Fleming (ICE President 1999-2000); Andrew Wyllie, Chief Executive at Costain (Vice President 2015-2016) and Takomborerwa Hove, a graduate of 2011 and one of the six ICE president apprentices to the 150th president Professor David Balmforth. While the students appreciate that it will be unlikely that they will see office as leader of the ICE, the alumni provide worthy role models to motivate them and demonstrate that the research and writing of their own, personal address has real-life significance

4. The Coursework

An extensive literature review undertaken for this paper suggests that no other scholars in any discipline have employed the inaugural addresses of the presidents of professional institutions as a body of knowledge suitable for use in an assessment with undergraduates. However, one former 'professorial' president of the ICE appears to have adopted a similar perspective:

> At Imperial, among other courses, I teach first year undergraduates a subject called the Context of Civil Engineering - indeed many of us participate. Among the coursework the students are invited to choose eminent civil engineers from the past and write about their life and works in the context of definitions of science, engineering, technology and innovation. (Ridley 1995, 5)

The coursework requires students to select six inaugural addresses of ICE presidents, two each from the nineteenth, twentieth and twenty-first centuries. They were required to read and take note of significant aspects (sociological, technological, economic, environmental, ethical and political) of each address. Key learning objectives include: (1) to learn how and (2) why engineering / civil engineers have shaped local, national and international society. Drawing on engineering storytelling as an educational instrument appears to converge with the views of other academics including Gaynor and Crebbin (2013) who believe that the first year of university study offers considerable potential for introducing historical narratives into the syllabus. Moreover, the coursework offers the students ownership of their learning and a considerable amount of academic freedom to incorporate prior learning, or what Foster (1999, 251) calls ‘cognitive maturity’, into their coursework.

Typically, students are surprised to learn that the scope of civil engineering is much more extensive than just requiring them to use their existing concepts in mathematics and physics sciences to design structures. A number of the ICE presidents (see Murray and Ross 2014, 78) have addressed the wicked problems of poverty, resource depletion and pollution and a few students are able to connect with prior secondary school learning from topics as diverse as geography and politics. Moreover, this focus on prior learning is actively promoted in class through challenging the students to envisage the role of aesthetics (art) in engineering designs and the possibility of learning from nature (biology) through biomimicry, thus encouraging the students to reflect and connect knowledge from their school studies. These structured interventions promote a constructivist approach to learning through presenting the students with an opportunity to mesh prior knowledge with new learning, and to construct their own understanding and meaning through active

rather than passive learning. As such, the tutor's role becomes one of the 'guide on the side' rather than 'the sage on the stage'. (King 1993)

The students use the six addresses as both inspiration and template to engage in 'role-play' and write (circa 2000 words) their own inaugural ICE President address. Unlike the majority of undergraduate academic writing, the students are encouraged to adopt the first person and Fairbairn and Fairbairn (2001, 13) have argued that this can promote the 'rigorous development of arguments'. Students are required to use a minimum of one quotation from each address (the 'standing upon the shoulders') in developing their 'own' vision towards the year 2050. They are encouraged to provide credible examples of bold / visionary / inspirational ideas and to support their research with contemporary references (i.e. books and newspapers and magazines such as the *New Civil Engineer* / *New Scientist*). As such, this assessment tends to be atypical to what engineering students expect (transmission learning characterised by convergent thinking with an emphasis on the right answer) but it does provide students an early opportunity in their studies to engage in independent learning characterised by choice, creativity and divergent thinking (Light and Cox 2001). Moreover, the aim of the coursework finds support from those commentators seeking to improve the educational experience. Student undertaking this coursework are dissuaded from adopting a mainstream and arguably instrumental approach to knowledge acquisition. On the contrary, this coursework is designed to stimulate the student's imagination and endorse intellectual risk taking:

> Schools should foster a love of learning and enquiry, a thirst to discover and uncover a sense of fun and creativity. Whether learning about the past or developing ideas for the future. (Claxton and Lucas 2015, p IV)

While the students are not tasked with interrogating the transcripts with the rigour required by an undergraduate enrolled on a history degree, the composition of the addresses (often biographical and / or auto-biographical) provide an opportunity to imagine what it would be like to have walked a mile in their shoes. Fairbairn and Fairbairn (2001, 78) offer advice to those students who find the coursework challenging:

> It can be useful to imagine, as you read, that she is sitting beside you. What images come to mind as you read her work that you would like to share with her? What feelings does her work evoke in you, that you feel it would be right to share? What questions would you want to ask?

As stated, the coursework is not a scholarly exercise in biographical research although it is recognised that it is important to provide first-year students with research experiences that will help them think like professionals (Jenkins and Healey 2013). The educational objective is far more accessible-develop a student's anticipatory socialisation of their future professional arena and introduce them to a global civil engineering community of practice while studying at university (Reid et al 2010). The learning experience is supported with exemplar papers (i.e. Chrimes (1993) analysis of Sir John Fowler and Barnes's (2007; 2013) interest in Thomas Telford and Joseph Locke) to demonstrate more exploratory biographical studies of former presidents. Further papers from Chrimes (2004a; 2004b) are also used and these are particularly suitable given they are based on the research undertaken for Skempton's (2002) *Biographical Dictionary of Civil Engineers in Great Britain and Ireland 1500–1830*.

Given the lack of engineering history presently taught in mainstream curricula, the use of ICE president addresses for student assessment is both innovative and novel. The coursework encourages students to be critical and independent in their thinking while simultaneously reflecting upon the context of what is being learned (Bourne and Neal 2008). The overriding educational principle fits with an 'assessment for learning' (AfL) philosophy. According to Sambell et-al (2013, 10), 'the principle of authenticity is vitally important when it comes to designing effective AfL environments'. These authors advise that authenticity implies 'the use of activities that are inherently meaningful, interesting, relevant, and have long term value' (Sambell et al, 2013, 12). Given that the addresses offer the students an opportunity to engage and learn from past engineers, and to propose their own vision for civil engineering towards 2050, the coursework is considered to meet this performance criterion.

The marking criteria has five primary components; namely, introduction (15 marks), content (25 marks), clarity, writing style and referencing (25 marks), vision (25 marks) and conclusion (10 marks). The coursework is marked out of 100. All students receive formative and summative feedback on their performance. The top five students are invited to present their address to the subsequent cohort of new first- year students and this has some alignment with the concept of a 'flipped classroom' (Mazur, 2013). The audience is made up of first-year civil engineering students and after the five students have made their presentations, the audience vote for who they would like to be invested as the Strathclyde ICE student president.

5. Have the students seen further?

The student addresses (n=428) provide a bank of data for a rigorous interrogation (a thematic or content analysis of the narrative) that would enable rich interpretations to be drawn from the personal narratives. However, the purpose of this paper is to support the call for historical engineering in the syllabus and to introduce the coursework as exemplar suitable for adoption and adaptation by other academics. Nevertheless, the validity and utility of this coursework necessitates an offering of evidence that would demonstrate that the students have indeed seen further. A definitive 'acid test' based on the current data collection is problematic given some of the limitations and assumptions implicit within a study of this nature. For example:

- How tall is each of the presidential giants (perhaps as a measure of professional esteem / successful projects (ideal for a novel set of Top Trump cards!)? Does the giant's metaphorical height aid and encourage the students' curiosity?
- Do first-year students have a higher propensity to be blighted by myopia (short-sightedness) or alternatively hyperopia (long-sightedness). What impact will this have on their ability to view the contours of the landscape (potential learning) from the giant's shoulders?
- Do the students need a mobile elevated work platform (MEWP) to help them access the giant's shoulders? Educationalists refer to aiding students with

temporary support (instructional scaffolding) to enable them to take ownership of learning and become successful independent learners. First-year students in transition to university studies may require structural underpinning and shoring arrangements to ensure they successfully construct foundation knowledge and understanding from the coursework.

5.1 The 'Persuasiveness' Factor

Table 1 shows the total number of students who read each address and how many students considered the respective address to be the most influential of the six addresses they read. The persuasive factor is a measure of 'total read' divided by 'most influential' address. For example, the presidential address given by Paul Jowitt (2009-20010) was read by 107 students and rated by 51 of those students as the most influential address of the six chosen. This gives a persuasiveness factor of 47% (51/107 x100). The authors acknowledge the potential for a more extensive interrogation of each students address (coding / content and thematic analysis). This would disclose the quotes extracted from the addresses and used by the students to develop their own thoughts and vision towards 2050. All data should be interpreted 'with care' and numbers stated do not constitute a scientific assessment of the most popular ICE president.

Based on a student population sample (n=428) each reading six addresses, a total (N=2568) should have provided an equal balance of (n=856) over all three centuries. While the students were instructed to select two addresses from each century, this was ignored by a portion of the students. The resultant breakdown was as follows: 31% (n=804) addresses were from the nineteenth century; 49% (n=1255) from the twentieth century and only 20% (n=509) from the twenty-first century. This anomaly has distorted the totals for the number of students reading particular addresses. Consequently, a disproportionate distribution across the three centuries of ICE presidents address introduces a research bias that hinders any meaningful comparison.

During the first two years (2009-2011) that the coursework was used, the students had a strong preference for selecting the addresses of the then current presidents, Jean Venables (2008-2009) and Professor Paul Jowitt (2009-2010). Their popularity is likely to have been bolstered further given that Jean Venables was a visiting professor at Strathclyde (2009-2011) and Professor Jowitt was an invited guest at the first competition event held in October 2011. However, these contextual factors fail to explain the popularity of the third president Sir John Rennie who accounted for the second highest number of students (n=102). While his physical presence was impossible, his spirit and sentiment continue to resonate with a contemporary audience:

> Every member of the Institution should look forward to becoming President, as one of the most laudable and honourable objects of ambition in his professional career. (Rennie 1847, 30)

Table 2 provides a list of the terms most popular in student address titles. From the total addresses (n=428) 30% (n=127) used the term ‘future’. The second to fifth most popular terms (address, ICE, president and inaugural) are to be expected, while the sixth most popular term ‘change’ only accounts for 6% (n=27). However, the address titles illustrate that the students acknowledge that change is inevitable and that civil engineering is considered as having a significant role in global matters.

Table 1. Persuasiveness factor.

Succession	President	Session	Persuasiveness factor		
			Total read	Most influential	%
145	Paul Jowitt	2009–2010	107	51	47
144	Jean Venables	2008–2009	89	36	40
148	Barry Clarke	2012–2013	60	25	42
3	Sir John Rennie	1845–1848	102	21	21
143	David Orr	2007–2008	52	20	38
146	Peter Hansford	2010–2011	41	14	34
24	Sir Joseph William Bazalgette	1883–1884	66	13	20
130	Dr Edmund Cadbury Hambly	1994–1995	49	11	22
82	Sir William Thompson Halcrow	1946–1947	51	9	18
119	James Anthony Gaffney	1983–1984	21	8	38
13	Sir John Fowler	1865–1867	27	8	30
147	Richard Coakley	2011–2012	39	7	18
150	David Balmforth	2014–2015	10	7	70
33	Sir Benjamin Baker	1895–1896	60	7	12
141	Gordon Grier Thomson Masterton	2005–2006	30	6	20
128	Michael Norman Tizard Cottell	1992–1993	34	6	18
113	Sir Alan Muir Wood	1977–1978	37	6	16
149	Geoff French	2013–2014	12	6	24
112	John Walter Baxter	1976–1977	21	5	24
122	David Gwilym Morris Roberts	1986–1987	23	5	22
140	Dr Colin John Clinton	2004–2005	22	5	23
11	Sir John Hawkshaw	1861–1863	50	5	10
41	Sir Guilford Lindsey Molesworth	1904–1905	8	5	62
7	Professor Charles Inglis	1941–1942	15	5	33
129	Stuart Norman Mustow	1993–1994	19	5	26
142	Quentin John Leiper	2006–2007	15	4	27
137	Mark Whitby	2001–2002	9	4	44
131	Professor Tony Melville Ridley	1995–1996	19	4	21
123	Sir William Francis	1987–1988	14	4	29
121	Donald Arthur David Reeve	1985–1986	14	4	29
117	Ian McDonald Campbell	1981–1982	24	4	17
36	Sir Douglas Fox	1899–1900	33	4	12
5	Sir William Cubitt	1849–1851	19	4	21
2	James Walker	1835–1845	39	4	10
31	Alfred Giles	1893–1894	25	4	16
8	Robert Stephenson	1855–1857	55	3	5
34	Sir John Wolfe Barry	1896–1898	31	3	10
45	Sir James Charles Inglis	1908–1910	15	3	20
46	Sir Alexander Siemens	1910–1911	30	3	10
61	Sir William Henry Ellis	1925–1926	14	3	21
79	Sir David Anderson	1943–1944	9	3	33
116	Peter Arthur Cox	1980–1981	13	3	23
125	Professor Peter Frank Stott	1989–1990	30	3	10
132	David F. Green	1996–1997	22	3	14
135	Professor George Fleming	1999–2000	25	3	12
138	Professor Adrian Long	2002–2003	5	2	40
136	Sir Joseph Dwyer	2000–2001	12	2	17
118	John Vernon Bartlett	1982–1983	32	2	6
109	Sir Kirby Laing	1973–1974	17	2	12
92	Harold John Frederick Gourley	1956–1957	14	2	14
86	Sir William Henry Glanville	1950–1951	21	2	10
75	Sir Clement Daniel Maggs Hindley	1939–1940	10	2	20
72	Brigadier-General Sir Alexander Gibb	1936–1937	11	2	18
73	Sydney Bryan Donkin	1937–1938	7	2	29
70	Sir Richard Augustine Studdert Redmayne	1934–1935	9	2	22
68	Sir Murdoch MacDonald	1932–1933	3	2	67
60	Sir Basil Mott	1924–1925	33	2	6
74	Sir Alexander Richardson Binnie	1938–1939	2	2	100
25	Sir Frederick Joseph Bramwell	1884–1886	8	2	25

Table 1. Continued.

Succession	President	Session	Persuasiveness factor		
			Total read	Most influential	%
14	Sir Charles Hutton Gregory	1867–1869	8	2	25
10	George Parker Bidder	1859–1861	15	2	13
6	James Meadows Rendel	1851–1853	11	2	18
7	James Simpson	1853–1855	30	2	7
17	Thomas Elliott Harrison	1873–1875	9	1	11
18	George Robert Stephenson	1875–1877	23	1	4
23	Sir James William Brunlees	1882–1883	14	1	7
27	Sir George Barclay Bruce	1887–1889	13	1	8
28	Sir John Coode	1889–1891	8	1	12
32	Sir Robert Rawlinson	1894–1895	38	1	3
48	Sir Robert Elliott-Cooper	1912–1913	11	1	9
50	Benjamin Hall Blyth	1914–1915	12	1	8
51	Alexander Ross	1915–1916	15	1	7
53	Harry Edward Jones	1917–1918	17	1	6
65	William Wylie Grierson	1929–1930	8	1	12
84	Sir Jonathan Roberts Davidson	1948–1949	3	1	33
90	David Mowat Watson	1954–1955	15	1	7
91	William Kelly Wallace	1955–1956	12	1	8
94	Professor Alfred John Sutton Pippard	1958–1959	5	1	20
100	Sir Robert Meredydd Wynne-Edwards	1964–1965	3	1	33
102	Sir Ralph Freeman	1966–1967	16	1	6
105	Angus Anderson Fulton	1969–1970	21	1	5
111	Sir Norman Rowntree	1975–1976	16	1	6
126	Professor Roy Thomas Severn	1990–1991	9	1	11

A number of addresses show that students had engaged in imaginative and divergent thinking and were able to consider not only ‘known-unknowns’ but also ‘unknown-unknowns’ towards 2050. While the staple diet of addresses spoke of engineering issues related to problems such as flooding, only a small number of students examined the wicked global problems of resource depletion, pollution, poverty and overpopulation, despite a number of the address titles (Table 2) having a global or environmental intent. Perhaps, as Bourne and Neale (2008, 18) concluded, ‘grappling with messy global problems and complex contexts is unfamiliar territory for mainstream engineering education. ‘However, some of the more adventurous students prophesied human colonies on the planets and lunar base structures. Such thinking demonstrates that these students were perhaps ‘vaulting-off’ the giant’s shoulders with minimum assistance from these luminaries. While students could have made some logical connections and linguistic references to George and Robert Stephenson’s ‘Rocket’, it is interesting to note that there is a paucity of explorative research in engineering’s role in space exploration within the annals of the ICE / Institution of Structural Engineers (IStructE). In contrast, the

American Society of Civil Engineers (ASCE) have (i.e. Mottaghi and Benaroya 2015) established a commendable body of knowledge in this specialist subject.

No doubt this apparent lack of ambition in 'Great Britain' would have disappointed Isambard Kingdom Brunel had he been alive today. Moreover, most students are surprised to learn that the second greatest Briton (BBC 2002) and arguably one of the world's most revered engineers did not hold office as ICE president. Although, this "must always be a subject of regret to the profession, that in the annals of the Institution, a member so gifted and accomplished should not appear on their list of presidents" (Fowler 1866, 224), it is also a timely reminder that success, engineering or otherwise is not simply measured in honours received. Life is more complicated.

Table 2. Student address titles.

Term	Frequency	Address titles	
Future	127	*President*	*Environmental*
Address	81	I am the President of the ICE	A look into engineering with nature
ICE	87	ICE Inaugural Address/President Address/speech	Sustainable/society/and women in 2014/ our planet
President	73		Improving life for the next generation
Inaugural	33	*Personal*	Green/the futures/follow the path
Change	27	Most Awesome Speech	Climate change/carbon emissions/
Forward	19	I can't Believe I'm President/The greatest day of my life	
World	16		*Economy and cost*
Looking	16	*Past and future*	Cost cutting for a better future
New	15	Vision for the future/of ICE/is ours/responsibility	Optimising our industry
Tomorrow	15	Past to future/back to the future/the future is behind us/echoes of the past	Building our way out of economic depression and into a future forever
Better	15	The future is bright/stronger/greener/greater/ better/safer/secure/efficient	Investment in Infrastructure: investment in engineering
Past	14	The Times They Are A-Changing	
Vision	13	The past is our lesson, the future is our test	*Expressions*
Time	13		To prevail what cannot be prevailed
Challenges	11	*ICE and engineers*	Believe To Achieve
Sustainable	11	Civil Engineers/problem solvers/my profession/ potential of/ growing up	United we succeed
Engineers	10	ICE/inspiring/future of/educating/better/giants of/modernisation	Every Step We Make Prepares The Way For Another
Building	9	Engineers/empowering/inspiring/qualifying	Spokes of society
Brighter	8		Make the difference
Now	7	*Global*	Called to save the world
Learning	6	World/save/change/live in/engineered	
Together	3	When you've finished washing and dressing each morning, you must tend your planet	*Miscellaneous*
Environment	3	One small leap for civil engineering; One giant leap for mankind	Bangladesh
Difference	3	Engineers at the Heart of a Global Society	Work for Peace
Inspiring	2		New Skills for a Changing World

5.2 The competition

The competition is a fun element, but unfortunately due to logistical parameters is open only to students with the top five coursework grades. After progressing to second year, these five students are given the opportunity to present an abridged version (10mins) of their presidential address to the new cohort of first-year civil engineering students. The benefits are twofold. First, the experience helps students practice and refine their ability to 'communicate with confidence and clarity' to their peers through 'public speaking' (JBM 2009, 4). Second, for the new first-year students in transition to university studies it provides an introduction to the coursework and through observing peer role models and evaluating (oral and graphical communication and ideas and vision towards 2050) the five presentations, it situates them as 'informed insiders' (Sambell et al 2013) within an informal assessment process. In addition, as 'audience members' critiquing the top five student ICE addresses in terms of both content and presentation style, this experience helps them reflect on their abilities to deliver future presentations. After all the presentations have been made, the audience vote for their preferred candidate to be 'invested' as the University of Strathclyde student president of the ICE.

The positive testimonies from student presidents demonstrate that the competition component of the coursework provides additional educational benefits.

> *I enjoyed and relished the opportunity that was given to me. I have taken great pride from being elected as the student president of the ICE. From this experience I have definitely developed my confidence and presentation skills.* (Stuart Laing, winner 2011)

> *The Institution of Civil Engineers has its headquarters in a prestigious building with impressive interior displays honouring the legacy and present day success of its members. Looking at the names of famous engineers together with the portraits of past presidents and learning about the difference they made to society was inspiring. One of the highlights of the day was looking*

through Brunel's diary from 1835 which contained his notes on the Thames Tunnel with hand drawn sketches and also technical drawings of the design. (Sara Peat, winner 2013)

6. Conclusions

While it could be argued that the history and heritage of civil engineering practice and its people should be gratuitously threaded into 'every' subject specialism in the curriculum, it would appear that this subject remains the 'poor cousin' in all but a few universities. However, the inclusion of such interdisciplinary education within a course where the engineering student in transition tends to expect a technical dominant curriculum may not be welcomed by all students (Barnard et al 2013). Practising engineers reading this paper could no doubt assist such exploration by visiting universities to convey their own history in the making to the apprentice engineers.

Satisfying the stated requirements of the JBM (2009) guidance is possible through encouraging first-year students to become members of one or more of the JBM professional institutions. Encouraging membership and developing teaching strategies that enable the students to appreciate and gain knowledge about the diverse and global engineering community of practice that they have joined will help ensure that their transition through higher education studies maintains professional relevance. The ICE presidential addresses can help students embark on time-travel, a journey that has important lessons for the curious scholar, and practicing engineers engaging in their own CPD. Moreover, encouraging students to seek problems and ask questions are thought to contribute to student retention in higher education (Harding and Thompson 2011). The 'role-play' as president of the ICE has given students a shared point of reference and a 'voice' to express themselves and investigate complex issues in an imaginative manner (Bourne and Neal 2008).

This paper makes two notable contributions: (1) it introduces the inaugural address of ICE presidents as a body of knowledge suitable for undergraduate study and (2)

presents a framework for assessment that others can use. The coursework is replicable in any department / faculty where the students will join a vocational (accountancy, medicine, law etc.) community of practice on graduating.

The students who have undertaken this coursework did not find heroic narrative in the addresses that could compete with iconic orators such as Martin Luther King or Winston Churchill. Some did find particular addresses inspirational in the ‘great man’ manner due to the nature of the projects (i.e. Joseph Bazalgette’s London sewers) ICE presidents were associated with. However, as the students progress through their course of study they will learn that ‘to engineer is human’ (Petroski 1992) and that grand failures (particularly technological /financial/ loss of life) have been the catalyst for critical reflection, application and revision of scientific knowledge to engineering practice.

From this perspective, the addresses should have opened a door that encourages students to reflect on their responsibility as learners and as collaborators with the everyday ‘giants’ they will meet in their academic and industry communities of practice. Their own journey as life-long learners is infantile; a growing maturity can be aided by an understanding of construction history and its evolution through the technological epochs that are characterised by the economic, finance and the socio-political environment (Chrimes 2015) that span the presidential addresses. The learning experience can be considered as an advance towards a more social systems engineering education whereby students reflect on an assessment of self as ‘engineers in training’ and how institutional values, testimonies, customs and identities encourage and embed professional responsibility irrespective of student background, gender or nationality. Upon completion, student(s) individually and collectively will have engaged in a holistic approach to technological, scientific and liberal arts knowledge (Grasso and Burkins 2010) and in turn, will create, chart and define their own epoch in engineering:

> Great engineers will design splendid and exciting structures like the Forth Railway Bridge or the Forth Road Bridge and make us feel proud to belong to the same profession as they do. But it is on us, the ordinary run-of-the-mill

> engineers, that most of the industrial load falls and it is the average as well as the peaks which must be high. This is what the community has a right to expect of the profession. (Wynne-Edwards 1965, 5)

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