
Preface

There is now an overwhelming body of scientific research and political opinion which agrees that current patterns of energy and materials usage are unsustainable, whether in terms of availability or environmental impact. The problem is twofold. In the short-to-medium-term, the current approach to development is sub-optimal through inefficient utilisation of the world's resources while also causing unnecessary irreversible or long-term damage. In the medium-to-long-term, the earth's depleting resources and biophysical systems will struggle to withstand the exponential burden of over-population even at reduced levels of human ecological footprint. The severity of the problem is evident if one considers that the world's 43 main deltas are predicted to be under water within decades, removing one of the earth's most productive food regions that also happens to correspond to areas of significant human population density. The challenges that face us tomorrow have already started yesterday and are shaped by the things we do today, or indeed do not do. Our lives today are based on the most basic manifestations of progress, such as quality of sustenance, domestic and social environments, mobility and leisure, and most significantly, are based on convenient and reliant energy production in the consumption and use of the world's resources. However, we are now at a turning point where we need to make decisions with objective reference to our longer-term quality of life, with respect to our own future generations and the 'global ecological justice' for those in all parts of the world. Sir David King (UK Chief Governmental Scientist) is of the opinion that climate change is a bigger threat than global terrorism and is the key challenge for the 21st century. However, the recent Stern Report (2006) proposed that the economics of meeting and working with climate change to achieve a sustainable future is not out of scale with current and future economic potential. Therefore, concurrent engineering through collaborative enterprise will have a crucial role in the 21st Century in the provision of a balanced solution to industrial and economic activity that respects environmental and sustainability requirements.

In the context of sustainable industry, companies must provide their products and services with greater resource efficiency and/or a reduced negative impact on the environment. In industrial processes, this would mean energy efficiency, resource conservation to meet the needs of future generations, safe and skill-enhancing working conditions, low waste production processes, and the use of safe and environmentally compatible materials. This can only be achieved for products and services through a concurrent engineering approach to a life-cycle balanced solution. Until recently the

emphasis in industrial processes has been on improving the energy efficiency and, due to legislative requirements, there has been a shift towards improving the safe working conditions and skill-training of the work force. However, the current strategy is to give more emphasis to resource conservation, by a process of not only “reduce, reuse and recycle” strategies, but also through innovative designs and the use of environmentally compatible materials. Materials technology is now seeing the utilisation of nano-composites to enhance mechanical and biodegradability of polymers while advanced composites are being used in applications ranging from bridge decks to aircraft wings. Structural composites, polymers and even geopolymers are increasingly used in both aerospace and construction industries to provide increased structural performance whilst reducing the volume and weight of materials, and the energy used to manufacture them. The value of good design and engineering is becoming more and more prevalent in the balance between meeting customer demands at an acceptable cost; whether economic, social or environmental.

Allied to the current strategy being taken up in many developed countries is the adoption of environmentally friendly and low carbon technologies, in which the release of greenhouse gases, such as carbon dioxide and nitric oxide, is kept to a minimum. Industry and the built environment are enormous users of energy whether directly in processing or through the treatment of waste; some 40% of CO₂ is generated by buildings and the cement industry alone producing upwards of 5% of the world’s CO₂ emissions. In tandem with technological and process improvements, the economic incentive for concurrent engineering excellence may be enhanced and aided by certain economic instruments; such as carbon taxation and tradable pollution permits to name but two debatable examples. However, in today’s concurrent and collaborative engineering environment, reduction of carbon dioxide is being achieved by a combination of innovative approaches in the design and manufacturing process, operations, and the utilisation of materials, with supporting recycling and waste management strategies.

Another high profile example of the challenges facing use today is the aerospace industry, which accounts for some 2% of global CO₂ emissions but is heavily dependant on oil, an energy source on which the world is overly dependent. The world’s oil reserves are finite in the medium term but yet there is an immediate business, leisure and defence dependency on the compressed transportation time offered by air travel. There are also serious ecological impacts of air travel due primarily to pollution but also noise, as identified by ACARE in their VISION 2020 initiative. However, the demand for air transportation is predicted to rise exponentially over the next few decades, leading to a much greater potential impact on the environment. For this reason, the European Union has set targets for the year 2020 that include a reduction of nitric oxide emissions by 80%, carbon dioxide by 50%, noise by 12 dB, and cost by 50%, with a five fold increase in safety. These targets have set challenges in the aerospace community in terms of innovation and integration that will

necessitate state-of-the-art concurrent engineering practices. The introduction of emission trading in the aviation industry may provide further economic incentive for reaching some of these targets but dramatically new solutions from a concurrent engineering approach are being demanded in propulsion technologies and fuel, energy consumption, vehicle design, air transportation management and environmental footprint management.

The immediate response of many countries and governments has been to set ambitious targets in the field of renewable energies. For example, The Renewable Obligation of the UK targets an increase in the proportion of electricity provided by renewable sources of at least 10% by 2010, with suppliers to source a specific and annually increasing proportion from renewables until 2027. As well as wind and solar, this has led to renewed interest in marine renewable energy in the form of ocean waves and tidal currents as a vast and virtually untapped resource. However, the concurrent engineering challenge of harnessing this to produce economic and reliable energy is considerable; its commercial exploitation being in its infancy but expanding rapidly. This is all in the context of renewed interest in the potential solution provided through nuclear energy, perhaps best representing the complexity of the trade-offs to be considered in addressing the provision of energy to support our 21st Century lifestyles and patterns of consumption, but in a truly sustainable manner.

It is certain that socially, contemporary and future policy design in relation to combating climate change and managing the transition towards a post-carbon energy economy will require the ‘upstreaming’ of public engagement and widespread public acceptance and ‘buy in’. Equally, the rise in the geo-political importance of ‘energy security’ has now become coupled with the policy and political debates around climate change and renewable energy generation. An issue here is the politics and deliberate use and misuse of the science around climate change within the popular media, making the whole issue of climate change and our responses to it confusing and non-coherent for many citizens, consumers and policy-makers. These social and political considerations must be incorporated into the concurrent and collaborative engineering enterprise in order to make research policy-relevant as well as scientifically and technologically innovative.

It can be concluded that sustainable development is actually very positive in not only seeking technological solutions through a restricted short-term market view but rather, through a more expansive truly concurrent approach that must be adopted in synthesising all of the far reaching requirements and implications relating to products and their intended operation, service provision and end-of-life. The need for sustainable development is increasingly driving the market to reach for new and innovative solutions that more effectively utilise the resources we have inherited from previous generations; with the obvious responsibility to our future generations. However, these solutions always need to be acceptable to governments, societies, local

communities and the individual consumer, and fundamentally, need to be economically viable in addressing 21st Century needs. Therefore, this will entail a just distribution of the costs, risks and benefits of economic development. The question of ‘environmental justice’, relative to environmental degradation and social exclusion, is emerging as a subject with enormous resonance in global, national and regional debates over sustainability and is an issue that institutions from the UN to local authorities are increasingly engaging with to promote the objectives of sustainable development. As a concept, environmental justice is explicitly recognised at a policy level by the EU and UK Sustainable Development strategies and in law by key EU and international sustainability instruments such as the UN Rio Declaration, the Aarhus Convention and, via the principle of common but differentiated responsibilities in the UN Kyoto Protocol. It is now true that even in the short-term, serious reputational, financial and legal risks are being faced by those acting in an irresponsible way towards the environment. It is only through interdisciplinary research developed in a truly concurrent and collaborative enterprise context that research solutions can be demonstrated to be “theoretically valid”, “environmentally friendly” and irrefutably “economically viable” in the sustainable future.

In closing these thoughts on the future direction of concurrent and collaborative enterprise engineering, served through the International Society for Productivity Enhancement (ISPE), it is encouraging to refer to the proposition expounded by McDonough and Braungart in their book ‘Cradle to Cradle’. Essentially, that we need to rethink the way in which we make things in order to revise the ‘Cradle to Grave’ philosophy of the Industrial Revolution that is inconsistent with nature’s principles and sustainable evolution; that human productivity and progress can be positively engineered and managed in harmony with the provision and needs of our natural environment, rather than sustainability being viewed as negative fixed constraints. McDonough and Braungart propose a new and fresh approach that provides an alternative route to utilising and enjoying the resources that nature has provided us, in exploring our future destiny in a more sustainable manner. One century on from the Industrial Revolution, this is now the time of the Sustainable Revolution; requiring holistic technological, process and integrated solutions to evolved socio-economic needs that are currently not well met in a sustainable manner. It might surprise Albert Einstein that he rather well encapsulated the nature of this evolutionary struggle when he stated: “The world will not evolve past its current state of crisis by using the same thinking that created the situation”.

And so it is our great pleasure to welcome you to go through the Proceedings of the 15th ISPE International Conference on Concurrent Engineering (CE2008) hosted by Queens University Belfast in Bangor, Northern Ireland. Previous CE Conferences have been held in São José dos Campos, SP, Brazil (E2007); Antibes-Juan les Pins, France (CE2006); Dallas, Texas, USA (CE2005); Beijing, China (CE2004); Madeira Island, Portugal (CE2003); Cranfield, UK (CE2002); Anaheim, USA (CE2001); Lyon,

France (CE2000) ; Bath, UK (CE99) ; Tokyo, Japan (CE98) ; Rochester, USA (CE97); Toronto, Canada (CE96); McLean, USA (CE95); and Pittsburgh, USA (CE94). The CE Conference series is organized annually by the International Society for Productivity Enhancement (<http://www.ispe-org.net>) and constitutes an important forum for international scientific exchange on concurrent and collaborative enterprise engineering. These international conferences attract a significant number of researchers, industrialists and students, as well as government representatives, who are interested in the recent advances in concurrent engineering research and applications. Concurrent engineering is a well recognized engineering approach for productivity enhancement that anticipates all product life cycle process requirements at an early stage in the product development and seeks to architect product and processes in a simultaneous and integrated manner. Therefore, it is fitting that this year the CE Conference Series considers “Product and Service Life Cycle Management for a Sustainable World” following on from last year’s focus on “Complex Systems Concurrent Engineering: Collaboration, Technology Innovation and Sustainability”.

You are invited to consider all of the contributions made by this year’s participants through the presentation of CE2008 papers collated into this Book of Proceedings, in the hope that you will be further inspired in your work in achieving Product and Service Life Cycle Management for a Sustainable World.

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