Editorial: Science and technology centres have come of age

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1 Introduction

Science and technology are increasingly being recognised as launch pads for nations to move up the ranks in the economic league [1,2]. Nations in the West have shown that this is an effective model for raising the socio-economic status of their people as well as promoting national development in the widest sense. The model has been replicated with some success in a number of Asian nations.

The relentless pace at which globalisation is shaping the techno-political landscape in today's society places a high premium on national competitiveness. Invariably, the emphasis on science and technology continues to be the cornerstone of the innovation-driven economy. Nations have come to realise that building science and technology capability and capacity is imperative for these efforts.

Receptiveness of people to the potential of science and technology for socio-economic development is a significant factor in the context of the foregoing initiatives. Formal educational structures such as schools, polytechnics and universities have contributed significantly to the build-up of science and technology expertise that is necessary to fuel economic development. Informal initiatives such as those from the print and broadcast media have also been helpful in orientating the perceptions of the citizenry towards the potential of science and technology for economic development.

As early as the late 1960s, there was recognition that informal initiatives that leverage on institutional mechanisms can be a complementary tool to tune the mindset of people to the immense potential of science and technology for their socio-economic wellbeing. Such initiatives, it was argued, would be more effective if pitched at the popularisation level because of the overarching outreach conferred. The concept of a science centre was thus born [3,4].

The Exploratorium in San Francisco is to be commended for pioneering the science centre movement and of making a success of it for others to emulate [5-7]. Soon, science and technology centres began to sprout in many countries in the West and later in Asia. The popularity of science and technology centres can be gauged from the fact that attendances at science and technology centres have been galloping in recent years and that more of them are being set up in various parts of the world.

It is thus clear that science and technology centres are playing a useful role in popularising science and technology among the masses, in the process reiterating their relevance to society, the economy and everyday life. It is the civic dimension that these centres impart in the process of promoting their mission objectives that is the hallmark of their success. Science and technology centres are now recognised as constituting an important part of the scientific, technological and educational infrastructure of many nations. They have added and imparted a useful dimension to the process of technology management through the pursuit of their mission objectives in their unique ways.

2 Special Issue of the Journal

The idea of coming up with a Special Issue of the *International Journal of Technology Management* on science and technology centres was predicated by the recognition that the science and technology centre movement has evolved to a significant level of maturity from its origins in the late 1960s, and that the time is appropriate to consider pertinent issues of significance under the auspices of a reputable international journal.

The *International Journal of Technology Management* has brought out several special issues of the Journal on pertinent issues: for example, technology foresight, management of intellectual capital, R&D management, university-industry-government relations, science parks, and so on. A full listing of the various special issues can be found in recent issues of the Journal. A special issue on science and technology centres has, however, not been attempted so far.

Against the backdrop of the foregoing, work on the Special Issue of the Journal started. To obtain submissions, direct solicitations were made to leaders in the science and technology centre movement as well as those in academia focusing on this field, encouraging them to suggest possible topics for exploration. This approach has helped to ensure that submissions do not reflect an eclectic array of topics but are instead embedded in context from the contemporary point of view of practitioners. A Call for Papers was also posted on the website of the Association of Science Technology Centres in the USA.

Submissions received were refereed for suitability. All submissions benefited from the scrutiny and comments of referees. A few submissions, however, were rejected. Submissions were received from practitioners from seven nations: the USA, UK, Australia, New Zealand, Singapore, Finland and Canada. It is fortuitous that the accepted submissions cover various issues of interest in the science and technology centre movement.

A brief commentary on the ten submissions that are featured in this Special Issue follows.

3 Submissions for the special issue

3.1 'Apoptosis: the way for science centres to thrive', by Goéry Delacôte, the Exploratorium, USA

The Exploratorium is widely recognised as the pioneer, leader and trendsetter in the science centre movement. Its programs are closely monitored by other science and

technology centres for insights into new approaches for popularising science and technology. Its Executive Director, Dr. Goéry Delacôte, needs no introduction as he is a respected authority in the field.

In a thought-provoking paper, Delacôte argues that the way for science and technology centres to survive in this millennium is for them to understand better the biological process of *apoptosis*. The term is used to describe a mechanism whereby diseased cells in worms can be genetically programmed to undergo a clean death without inflammatory action on the rest of the organism. Extending this metaphor as a form of *metamorphosis* to science centres, he suggests that there are useful lessons to be drawn from this analogy in order to ensure their mission objectives continue to be successful. Drawing upon a number of examples from the science centre movement, Delacôte provides insightful comments on how an understanding of the biological metaphor could have been put to good effect in the face of precipitating trigger points such as low attendance figures, initial expensive construction costs of buildings, mistaken or ill-conceived strategies, veering of mission to peripheral issues to the detriment of the core focus, and difficulties in adapting to changing circumstances. Delacôte also shares details of new initiatives that the Exploratorium has embarked on that would strategically allow it to circumvent problems and other challenges in this millennium in relation to the popularisation of science and technology.

The message is clear: it is important for science and technology centres to undergo frequent metarmorphosis within the framework circumscribed by their mission objectives in order to be resilient and be better able to cope with the new challenges of promoting science and technology.

3.2 'Building public knowledge: collaborations between science centres, universities and industry', by Alan Nursall, Science North, Canada

This paper explores the need for science and technology centres to embark on strategic partnerships with complementary organisations such as universities and industry in an effort to stay afloat, remain relevant and address new challenges in science communication among people. Nursall recounts several initiatives of such synergistic partnerships in the science centre movement that have helped to buttress the role of science and technology centres as nodal points for the popularisation of science and technology to the masses.

A discussion on the unique experiences of Science North in showcasing cutting edge research advances emanating from the nearby Sudbury Neutrino Observatory, whose findings challenged the Standard Model of particle physics relating to the building blocks of matter, as exhibits and ancillary programs, is particularly illuminating.

Nursall's stance reiterates the need for more science and technology centres to expand the reach of their mission objectives by working closely with local universities to display some of their important research endeavours in ways that the layperson can appreciate, as well as forge alliances with industry partners in strategic areas – after all, virtually all science and technology content emanates from universities and industry!

3.3 'Outdoor science centres', by Ronen Mir, Sci-Tech Hands-on Museum, USA and Fermi National Accelarator Laboratory, USA

The concept of an outdoor science centre is quite new, and is a late development in the science centre movement. Whilst traditional science and technology centres have their core focus mainly on indoor exhibition programs for the public, there are certain inherent constraints that preclude them from addressing varied themes, especially those that cannot be addressed within the physical constraints of an indoor setting or those which are not feasible on a larger scale. In this context, the outdoor setting sets the stage for science centres to present large exhibits as well as exhibits which can capitalise on the natural elements of light, wind, water and heat for their operations. An added advantage is that infrastructural requirements for outdoor science centres are minimal: they do not require buildings and the exhibits can be set up cost-effectively and speedily.

Mir brings considerable experience and expertise to this field, having been closely involved in the setting up of two outdoor science centres: the Clore Garden of Science in Israel and the Sci-Tech Hands-on Museum's Outdoor Science Centre in Illinois, USA. In his paper, he discusses various issues in the setting up of outdoor science centres: choice of themes, choice of exhibits, maintenance and safety issues, and draws upon the best practices of the two institutions that he has helped to set up.

Science and technology centres facing spatial limitations in the fulfilment of their mission objectives or those reaching a critical mass in visitation rates in their indoor settings may have to consider expanding their reach through the opening of an outdoor annexe. The concept of an outdoor science centre is also a particularly economical and cost-effective option for nations in the developing world to popularise science and technology among their people.

3.4 'What makes a successful outreach program? An outline of the Shell Questacon Science Circus', by Susan Stocklmayer, National Centre for Public Awareness of Science, Australia

A science circus is a natural extension of a science centre: it is a science centre on wheels. Whilst institution-based science centres generally cater to the needs of people and students in the general vicinity, people in rural areas often lack opportunities to savour the multi-faceted splendours of science and technology. Using the experiences of the Shell Questacon Circus, a mobile science centre initiative of Questacon, now known as Australia's National Science and Technology Centre, Stocklmayer documents rich insights on the mechanics and outreach effectiveness of such initiatives in reaching out to remote locations for popularising science and technology.

The experience of the Questacon Science Circus offers useful lessons for developing nations, especially those with large land areas or populations. Whilst traditional science centres here, where there is one, can consider expanding their reach through such outreach programs, there could even be a case for dispensing with the institution– and moving around the country as a science circus!

3.5 'Science and technology centres as agents for promoting science culture in developing nations', by Leo Wee Hin Tan and R. Subramaniam, Nanyang Technological University, Singapore

The authors argue that the insertion of science and technology centres in the scientific, technological and educational infrastructure of developing nations can be an effective way to promote a science culture among people, thus helping to catalyse a culture supportive of science and technology driven socio-economic development. They advance a framework for the setting up of such centres in the context of national initiatives and/or international developmental assistance. The authors draw upon the experiences of the Singapore Science Centre, a science centre in a developing nation and with which both were associated for quite a length of time, and also provide some useful insights on best practices.

3.6 'Science centre on a screen', by Bronwyn Bevan, Exploratorium Centre for Teaching and Learning, USA and Noel Wanner, Exploratorium Centre for Media and Communication, USA

Though science and technology centres generally promote their mission objectives through such avenues as indoor exhibitions, outdoor exhibitions, science circuses, etc, it is a testament to the resilience of the movement that they have not overlooked the potential of a new medium, the internet, to expand their reach and effectiveness in ways hitherto unthought of.

In 1993, when the internet was still in its nascent stage of evolution, the Exploratorium took the initiative to set up its own web page – this was considered to be the 600th website in the world, and the first by any science centre. Over the years, the breadth and scope of its portal offerings have mushroomed tremendously to promote new genres of learning on the web platform. Other science and technology centres have drawn inspiration from these efforts, so much so that most of them now have their own websites. This has also seen the gradual migration of exhibits and other science learning resources onto the web platform.

Bevan and Wanner recount some of the programs that have proved to be effective on the web platform for the Exploratorium in reaching out to new audiences. They also discuss the challenges of using technologies in ways that embed the Exploratorium's traditional pedagogical strategies in the promotion of science learning.

With the increase in personal computer ownership and internet penetration rates, it is clear that science and technology centres cannot overlook the potential of the web in popularising science and technology.

3.7 'Science and technology centres – rich resources for free choice learning in a knowledge-based society', by Lynn Dierking, Jessica Luke and Kristen Buchner, Institute for Learning Innovation, USA

A contribution from Dierking and co-workers, the former being well known in the science centre field through her scholarly works, this paper focuses on a variant of informal science learning that the authors refer to as free-choice learning – the likely

learning strategy of choice for most people in this millennium, and of how science and technology centres are strategically positioned to fuel these efforts in a learning society.

The authors introduce the conceptual model of learning, and marshal research findings from a study of the exhibition programs at two science centres: 'The World We Create' at the Louisville Science Centre, and 'Creative World' at the California Science Centre, to show that science centres can be pivotal platforms for promoting and facilitating social interaction and collaborative learning in the context of free choice learning through rich learning resources in science and technology.

3.8 'Science centres as learning laboratories: experiences of Heureka, the Finnish Science Centre', by Hannu Salmi, The Finnish Science Centre, Finland

Though science centres have made great strides in popularising science and technology among the general public, case studies of the effectiveness of their programs are rather sparse in the primary science literature and generally limited to the well established science and technology centres in the USA and UK. In the context of the foregoing, this contribution, which focuses on the Scandinavian experience with science centres, is a useful addition to the literature.

Salmi focuses on four case studies relating to the motivation of school groups when visiting Heureka, the Finnish Science Centre. The research findings suggest that well organised programs linking schools to the informal open learning environments of science centres are helpful in enhancing the motivation of students towards science and technology. The results of another survey show that these informal learning institutions do wield an important influence on the academic career choices of students, a noteworthy development indeed.

3.9 'Negotiated agendas: families in science and technology museums', by Theano Moussouri, Department of Museum Studies, University of Leicester, England

A key aspect of the programs at science and technology centres is the communal dynamics of the visitations that they engender. Visitors often come as a group: school students, families, community groups, etc. It is well established that this is an important aspect of the learning experience that is difficult to replicate in other settings.

Moussouri extends this argument further, and suggests that science and technology museums need to take cognisance of the expectations and perceptions of family groups when structuring their programs. She adduces evidence from a study conducted in Xperiment!, a science centre annexe in the Museum of Science and Industry in Manchester, to advance her thesis that science museums need to rethink certain aspects of their policy from the agenda of family visitors. The approach suggested can be a fruitful exercise for enhancing visits and for promoting a holistic experience in the learning of science and technology – however, this calls for a rethink on the traditional approach of science centres, as the approach generally concerns what they want to communicate to visitors, and not the other way round!

3.10 'Survival of science centres in New Zealand: what we can learn?', by Brian Taylor, Science Alive!, The New Zealand Science Centre, New Zealand

Though science and technology centres have made great strides in recent years in terms of increased visitor numbers, improved range of offerings and recognition of their role as purveyors of science and technology, they generally face a financial squeeze, even though most may not want to admit to this. Paucity of funds can have a debilitating effect on the operation of these centres, and this in turn can affect the promotion of their mission objectives. The repercussions on the public understanding of science and technology then take on graver overtones. There is thus a pronounced need for these centres to have a diversified portfolio of financial support – gate takings rarely, if ever, cover the administrative, operational and maintenance costs of these institutions.

Against the backdrop of the foregoing, Taylor provides some refreshing insights on how his own science centre, Science Alive! in New Zealand, has been able to adopt creative means of fund raising by leveraging on the core competencies of his institution as well as by drawing on other sources of support in an effort to stay afloat when others have been forced to close down or morph into other forms! The experiences of Science Alive! provide a good benchmark for other science and technology centres to emulate.

4 Conclusion

The science and technology centre movement is likely to pick up greater momentum in the current millennium as science and technology impacts further on various aspects of society and industry. Indeed in the emerging knowledge-based economy, the onus on science and technology centres to play a greater role in national efforts is likely to intensify.

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