The Impact of Science Centers/Museums on their Surrounding Communities: Summary Report

What is the Science Center Impact Study?

The science center impact study was initiated by a small, informal group of science center CEOs in 2001. These CEOs identified a need to make information about the impact of science centers readily accessible so that they could use it to both substantiate applications for funding and to justify the value of science centers in the community. The idea was discussed supportively at Board meetings of ASTC and ECSITE, and a Steering Group was formed: Dr. Per-Edvin Persson, chair, Dr. John Durant, Dr. Ann Ghisalberti, Dr. Tom Krakauer, Mr. Roy Shafer, Dr. Walter Witschey, and from 2002, Dr. John Falk.

What are the aims of the study?

The Steering Committee identified three main aims for the project:

1. To collect and collate reports and studies on the roles played by science centers in their communities.
2. To summarize and present these studies in a useful, accessible way.
3. To identify gaps in current knowledge on the impact of science centers.

Who funded the study?

In response to an invitation from Dr Per-Edvin Persson to full members of ASTC and ECSITE, an initial group of thirteen science centers decided to fund the research project. Each contributed US$2,500 to the project.

Who is carrying out the study?

The Steering Group appointed me, Robin Garnett, to carry out the first phase of the study. I have an Honours Degree in Science and a Masters Degree in Education. I have worked at science centers/ museums for the past eleven years and, until recently, was based at Questacon, Australia. Dr Annie Ghisalberti, the Director of Questacon, supervised my work on the project.

What was the method used in the study?

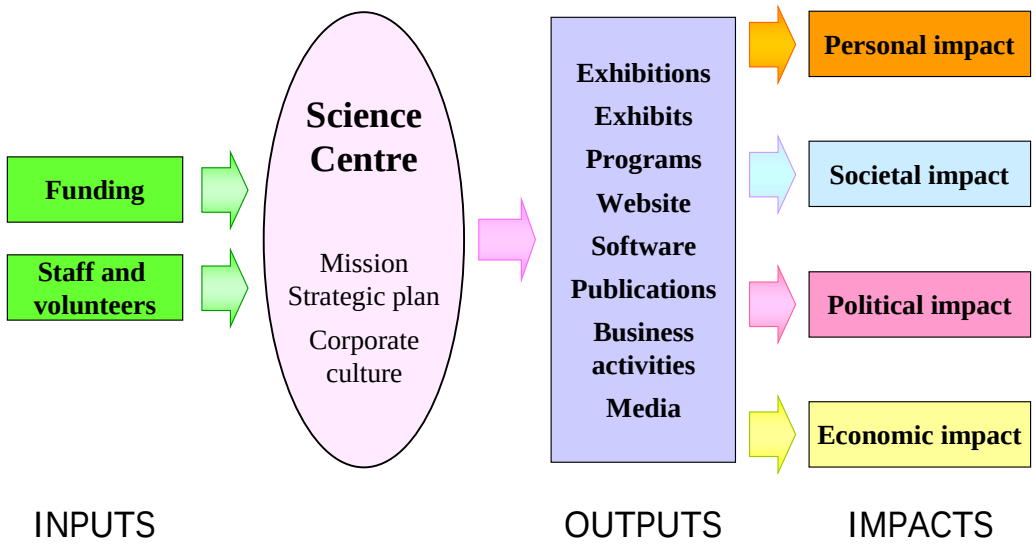
I began by gathering existing reports of studies into the impact of science centers on their communities. To acquire these studies, I sent emails to science centers and museums in science center networks (ASTC, ECSITE, ASTEN and ASPAC) requesting copies of published and unpublished reports relating to the impact of their institutions on their surrounding communities. (See Request for Reports in Appendix.) I also wrote to Australian colleagues who had recently carried out research in science centers, asking them to recommend relevant articles on the impact of science centers. I documented and summarized all reports in an EndNote computer database so they could be accessed easily using keywords. The database now contains over 180 entries. I also identified and listed a small number of key papers in the field that I considered particularly useful for the aims of the study.

How was the information organized?

To organize the in-coming reports, I developed a model based on the description of the impact of science centers described by Persson (2000). Persson described four main types of impact: learning impact, public impact, political impact and economic impact. I modified Persson's model slightly to provide a closer fit with the data I had received. I renamed 'Learning Impact' as 'Personal Impact' in order to broaden it to include such factors as personal enjoyment and career development. I also renamed the 'Public Impact' category as 'Societal Impact' in order to make it clear that the studies in this category relate to the society rather than to the individuals within that society. Persson's categories, 'Economic Impact' and 'Political Impact' remain unchanged.

The model I developed rests on the following assumptions:

- It focuses on the impact of a science center on its community of interest and does not attempt to model a science center's organization, operations or environment.
- The income for the science center may come from a variety of sources including government, donors, visitors, internal and external business enterprises.
- The primary audience for science centers may be on-site visitors and / or outreach programs in schools, public places or the Internet.



Model of science center impact

The model shows that a science center, with its mission, strategic plan and corporate structure relies on funding, staff and volunteers for its daily functioning. The science center produces a large number of outputs for its clients or visitors such as exhibitions, programs and a web site. These outputs have impacts on the science center's community of interest. If we can measure these impacts and show that they have the desired effects, we are in a strong position to provide evidence that justifies the value of the science center.

Definitions of terms used in the model

The *impact* of a science center is defined as the effect or influence that a science center has on its community of interest.

The *community of interest* is the group of people and organizations that the science center considers to be its clients or potential clients

The *Personal impact* of a science center is defined as the change that occurs in an individual as a result of his / her contact with a science center. It includes factors such as:

- Science learning
- Changed attitudes to science
- Social experience
- Career directions formed
- Increased professional expertise
- Personal enjoyment

The *Societal impact* of a science center is defined as the effect that a science center has on groups of people, organizations, and on the built and natural environment. Examples of societal impact are:

- Local / regional / international tourism
- Community leisure activities
- Youth employment
- Community partnerships
- Volunteer schemes
- Local clubs and societies
- Urban redevelopment
- Environmental restoration
- Infrastructure: roads, parking, transport

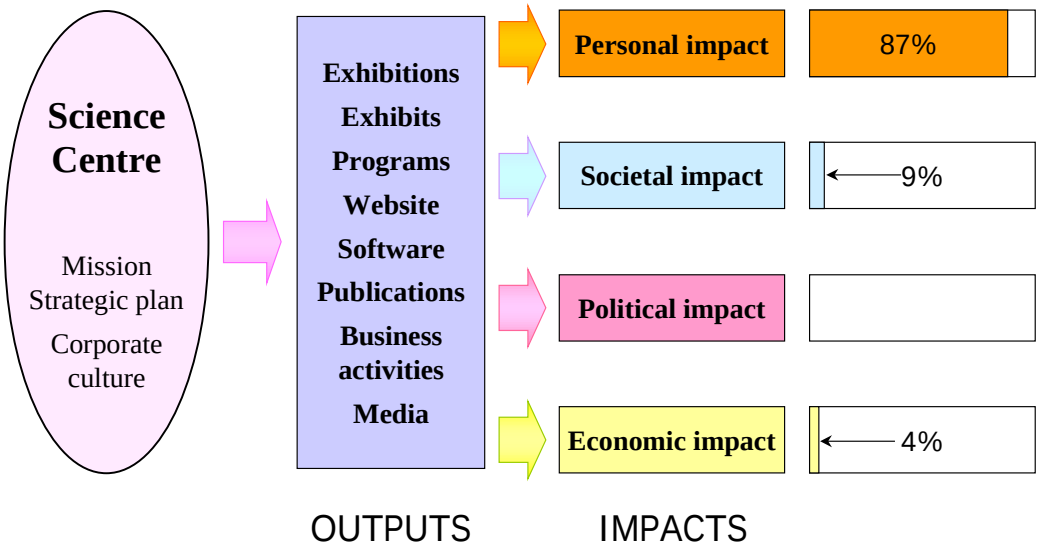
The *Political impact* of a science center is its influence on government policies and priorities. It is its impact on all levels of Government

The *Economic impact* of a science center is the direct and indirect effect it has on employment and the local economy. It includes measures such as:

- Income brought into the science center from visitors
- Income brought into community by visitors
- Science center expenditure
- Job creation for staff and outside providers

What were the main findings from the reports received?

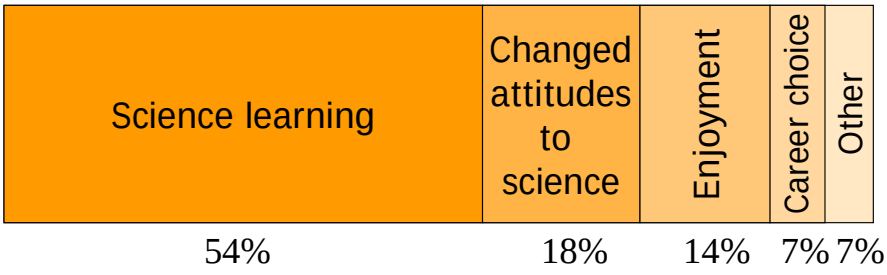
The number of studies of the impact of science centers has increased greatly in recent years. Science centers themselves are taking greater initiative in generating such research, as the need to be accountable to their funding bodies and the pressure to reach wide, diverse audiences has increased. The analysis in this report is based on the 180 reports provided by science centers and colleagues rather than from a complete survey of the literature in the field.



Published and unpublished reports seen in this study

By far the majority of the 180 reports received (87%) focus on aspects of 'Personal impact'. Some studies relate to Societal impact (9%) and Economic impact (4%) and, perhaps predictably, there were no published or unpublished studies on the Political impact of science centers.

The Personal impact of science centers



Percentage of reports relating to different categories of personal impacts

Within the Personal impact category most studies are concerned with science learning in science centers. Some studies look at the effect of science centers in changing attitudes to science and the enjoyment of visitors. A very few are concerned with the impact of science centers on career choice and on the professional development of teachers.

Piscitelli and Anderson (2000) write, 'In the 1980s, museum and visitor research studies were regarded as being in their infancy (Feher 1990). The intervening years have seen considerable growth and development in this field of research, although it can be regarded as having been in a formative stage throughout the past two decades. By the middle of the 1990s, there was widespread acceptance among researchers of the cognitive, affective and social aspects of the learning experiences of visitors in museums and similar institutions (Raphling and Serrell 1993). Rennie and McClafferty (1996); Rennie (1994); Roberts (1992) and Falk and Dierking (1992) had drawn attention

to the physical, social and personal contexts in which learning occurs. The highly stimulating, novel and interactive physical and social environments of museums have been linked to ineffective learning outcomes by visiting school students by some studies (Kubota and Olstad 1991; Anderson and Lucas 1997). Other studies of the 1990s period have demonstrated that students enjoy visits to museums tremendously and that increased interest and enjoyment of post-visit activities constitute extremely valuable learning outcomes (Anderson 1998; Anderson 1999; Ayers and Melear 1998; Ramey-Gassert, Walberg III et al. 1994); that persist over time (Anderson 1999; Rennie 1994; Wolins, Jensen et al. 1992.'

Bitgood, Serrell et al. (1994) reviewed over 150 articles, mainly from USA, in their chapter, 'The impact of informal education on visitors to museums' and drew the following conclusions:
'In summary, what do we know about the impacts of informal learning in science museums, zoos and aquariums, and where should we go from here?

1. That there are some impacts, and they are intellectual, emotional and physical, planned and unplanned.
2. That orientation, both psychological and spatial, is a very important factor that can influence impacts, positively and negatively.
3. That impacts are socially influenced and enhanced, most positively by exhibit characteristics that are appropriate to informal learning such as interaction, sharing, parental guidance and intimacy between visiting group members.
4. That impacts are environmentally influenced and enhanced, most positively by exhibit characteristics that are suitable to informal learning settings, such as concrete experiential activities, reinforcement of concepts and efficient communication techniques.
5. That measurements of specific impacts with the traditional tools of experimental design are often inappropriate for the confounding variability of informal settings, making the results of such assessment often disappointing or insignificant.
6. That impacts can be positively enhanced by using visitor feedback during the planning and development stages of exhibit design through front-end and formative evaluation.
7. That evaluation is essential to increasing the success of informal science learning in museums.
8. That future research on impact in museums needs to combine multiple, systematic methods and strategies that are appropriate to the voluntary, social, intrinsically motivated experiences that visitors have.
9. That there is a lot of room for improvement, even though visitors are coming to museums in droves and rarely complain.
10. That improvement in the amount of impact on informal science learning in museums - and its objective appraisal - is essential if museums are to be held accountable to their claims of having an educational role in society.'

Rennie and McClafferty (1995) synthesize educational research about learning in interactive science and technology centers from numerous sources and conclude that: 'visits to interactive science and technology centers, museums, aquariums, and zoos provide valuable motivational opportunities for students to learn science and they affect students' learning. Overall, the research suggests that students usually find visits enjoyable but both the amount and nature of their cognitive and affective learning vary. The factors examined in the research literature indicate that learning is influenced by the extent to which students are familiar with the setting, their prior knowledge, the

match between the cognitive level of students and the thought processes required by the exhibits, the degree of structure of the visit, the provision and nature of the cues for learning, and the social aspects of the visit.'

More recent studies have looked in depth at the change in students' understanding of science as a result of a visit to a science center (e.g. Anderson 1999) and have found convincing evidence that students' understanding is changed as a result of a visit to a science center. The learning that occurs depends on a variety of characteristics of the learner (e.g. prior knowledge, interest) and is mediated by other people (e.g. friends, parents teachers) and is influenced by other sources of information in the student's life (e.g. books, TV programs, school, the Internet, friends, family).

Rennie and Williams (2000) studied the effect of a visit to a science center on the image of science held by adult visitors. 'In summary, the findings of this research are very encouraging. Clearly, a visit to the Center makes a measurable impact on most of the visitors. Given the short time of the visit, that adults often were in charge of children, and that they all bring unique combinations of background knowledge and experiences and consequently have different visit experiences, it is surprising that any effect was measured.' However, the authors express some concern that, as a result of the visit, visitors became stronger in their opinion that scientists agree with each other and that science provides definite answers – views that do not reflect an increased understanding of the way that progress in scientific knowledge is made.

Falk (2001) have stressed the important role of 'free-choice learning' in the public understanding of science i.e. learning from out-of-school educational experiences. As part of a ten year L.A.S.E.R. project that they are undertaking in collaboration with the Californian Science Center, they interviewed over a thousand Californian residents and found that they had a high level of interest in science and technology, regardless of age, race ethnicity, income, education and gender. The people they interviewed also considered that their knowledge of science was average or slightly higher than average. Almost everyone could name at least one area of science that really interested them and nearly half of all those surveyed said they had learned their science and / or technology during their leisure time (Falk 2002). Museums ranked fourth, after books, life experiences, TV and school as a source that interviewees used 'some or a lot' for learning about science and technology.

A growing number of in-depth research studies are showing that a science center visit may influence an individual in an idiosyncratic, eclectic way far into the future. For example, Spock (2000) interviewed museum professionals and asked them 'to tell stories about pivotal learning experiences they had or observed in museums'. He writes, 'Of 400 discrete narratives recorded in the interviews, nearly 200 described pivotal learning experiences and thirty to thirty five stories 'were identified as truly life-changing museum experiences'. The memories of the museum professionals in this study reinforce the qualities of a museum experience that Jensen (1994) found important in her study of children:

- a match to personal interests and family and cultural backgrounds,
- control over content and pacing,
- some measure of independence from adults, and
- variety in activity and content.

Falk and Dierking (2000), summarize the key points about documenting learning from museums as follows:

- 'Over the years providing compelling evidence for learning from museums has proved challenging. This is not because the evidence did not exist, but rather because museum learning researchers, museum professionals, and the public alike historically asked the wrong questions and searched for evidence of learning using flawed methodologies.
- Recent research using an appropriate search image and set of assessment tools strongly supports the premise that museum learning experiences facilitate some degree of learning in virtually all participants.
- Visitors learn in all kinds of museums about all facets of human knowledge, including history, science, and art. Visitors learn broad generalizations and show generalized increases in understanding and interest; however, the specifics of what they learn are normally highly personal and unique.'

Gaps in research into the Personal Impact of science centers

Rennie and McClafferty (1996) list the following research as being needed:

- Ways that science centers can encourage girls into maths and physical sciences.
- Assessment and description of the nature and communicative activities of science museums and science centers.
- Research on equity of access to people from different races and cultures.
- What kinds of image of science are presented by science centers to their visitors and the public, and how those images are communicated. (Rennie has since made a study of this last question in Rennie and Williams (2000), a study that will also be published in *Science Education* in 2003).

Anderson (1999), writes 'there are several areas in the fields of learning and museum studies which are under-researched, in particular, the processes of learning resulting from museum-based experiences; the role of prior knowledge in learning resulting from museum experiences; the criteria for design of post-visit activity experiences; and effects of post visit experiences on subsequent learning.' Anderson's PhD thesis addresses these questions in case studies of five students who visit a science center to study electricity and magnetism.

Lynda Kelly, Head, Australian Museum Audience Research Centre writes,
'There is a vast literature about how people learn and how they learn in informal or free choice contexts. There has been fewer long-term studies that have assessed the long term impact on learning of a visit to a science centre.'

Science centers and their influence on careers

There are very few studies of the effect that science centers have on students' career choice. Woolnough (1994) showed that extracurricular science activities encouraged students to study science at school and to pursue science careers. Coventry (1997) surveyed university students. She found that 80% of students studying for science-based careers had visited the science center in Perth, Australia at least once whereas 64% of students who were not studying for science-based careers had visited Scitech. Similar findings were made by Salmi (2000) in Finland. There is evidence that youth programs in science centers have encouraged participants to pursue careers in science teaching (Siegel 1998).

The societal impact of science centers

Witschey (2001) writes of the Science Center of Virginia as 'the power house of the community' and describes a rich array of partnerships and programs that the Museum undertakes with its community. This is undoubtedly the case in many communities that are served by science centers.

The St. Louis Science Center runs a Youth Exploring Science (YES!) program in which the-Science Center works with Job Training groups to provide a year round work-based training program. Science centers increase tourism to their local area. They run youth employment and volunteer schemes. They support local clubs and societies. They develop special programs for the elderly and for people with disabilities. They are involved with environmental rehabilitation and they affect the roads, parking and transport systems in their area.

Lipardi (1997) describes how the Città della Scienza works with local councils, firms and research centres in order to enhance the development potential of a geographical area, with particular emphasis on the development of local industry.

However, although science centers have put many programs in place that benefit society, on the whole, they have not developed the methodology to measure the impact that they have at a societal level. Sheppard (2000) makes a strong plea that they should do so: 'As museums engage more substantially in building social capital and partnering in their communities, they need strong, effective evaluation methodology to measure their work. Anecdotal information suggests that community outreach may be transforming both museums and the communities they serve. To support further investment in community partnership, however, museums and their publics need to test such assumptions through consistent and methodical research. Museums have many stakeholders to convince, from their own board and governance to public and private funders and ultimately the public that chooses to engage in the rich programs they offer'.

The political impact of science centers

Science centers have, understandably, not published reports about the ways they have/ have not been able to influence government. They do not necessarily want to publicise the means they use to gain government support. However we can question whether it would be useful for science centers to share case studies and stories of success and failure in this area. Perhaps there are some strategies being used by some science centers that could usefully be implemented or adapted by others.

The economic impact of science centers

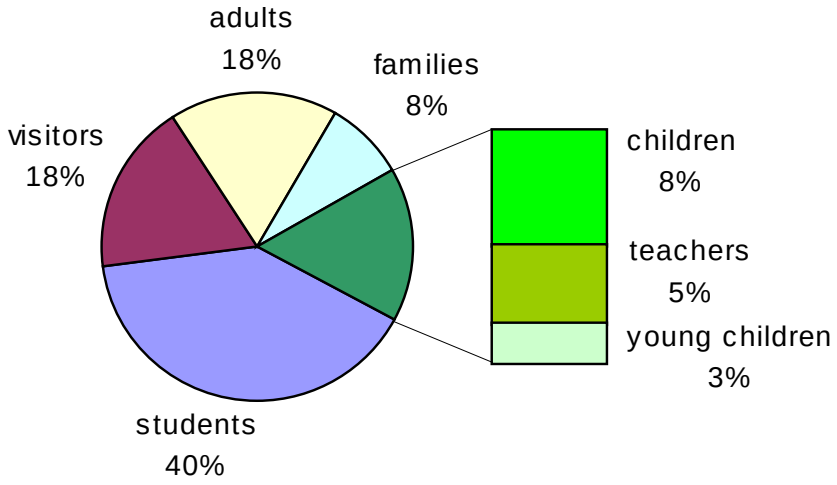
During the past few years, a few science centers have calculated their impact on the local community in terms of the extra money brought into the community by visitors to the science center and extra jobs created by the science center.

For example Greene writes, 'For every pound sterling spent by visitors at the museum (The Museum of Science and Industry in Manchester), twelve pounds is spent elsewhere in the local economy. With 300,000 visitors spending £1.5 million in 2000, the contribution to the prosperity of the region was £18 million. To this can be added the goods and services purchased by the Museum from local business, the employment of 120 people, and the investment in new exhibitions and building work.' (Greene 2001)

Krakauer (2001) states that the North Carolina Museum of Life and provides the Durham community with year round jobs for 65 adults and 25 youth - 150 jobs in summer. It also provides real life work and learning opportunities for 170 young people annually. 'For every dollar generated by the Museum from Durham County government or residents, an additional two dollars are brought into the county from outside Durham.'

An analysis of the economic impact of The Tech Museum of Innovation on Santa Clara County in 1999 concluded that visitors to the museum contributed $44.2 million in economic output and $14.8 million in personal income and 802 jobs to Santa Clara County. The methodology for the economic impact analysis of The Tech Museum of Innovation on Santa Clara County is set out clearly (Morey and Associates 2001) in a paper that is available from The Tech.

Which segments of the science center audience have been studied most frequently?



Percentage reports relating to different categories of audience as described by the authors

The figure above shows that 40% of the research studies collected focused on students (primary, secondary and tertiary students). Studies of families, teachers and young children were much fewer. The frequency of research studies for particular audiences does not reflect the frequency that these groups visit science centers.

Who can access the annotated bibliography of impact studies?

The bibliography is available to the original thirteen subscribers who funded the project as well as to new subscribers. Contact Dr Per-Edvin Persson for information about access to the bibliography and the next stages of the project.

Conclusion

In this project, over 180 papers were collected in response to a request for reports on the impact of science centers on their surrounding communities. The majority of research studies were found to concentrate on the impact of science centers on individuals. There is a need for more *long-term* studies of the impact of science centers on individuals. Some recent, long-term studies demonstrate that visits to science centers foster further interest in science and stimulate further enquiry far into an

individual's life. New ways of questioning visitors are showing that almost all visitors gain some degree of learning from their experiences in science centers.

There is a need for more research into the influence of a science center on the society in which it is situated and upon particular, targeted groups within that society. Although science centers are involved with many projects in their local society, such as programs with the elderly, with disabled people and with unemployed youth, there have been few attempts to assess the societal impact of these programs.

There are a small number of studies of the economic impact of science centers. These show that considerable employment and income is generated by science centers. More economic impact studies would contribute to a stronger public awareness of the positive effects that science centers have on employment and income creation in their local area.

Although most science centers aim to influence government policies and funding, perhaps understandably, they have not shared their methods and successes publicly. Each science center has a distinctive relationship with government and it may or may not choose to share its strategies for influencing government effectively. It is possible that, in future, successful ways of generating political impact could be shared through case histories of particular science centers.

The results of research into the impact of science centers are particularly valuable for the science centers that commission the research. However, it is helpful for other science centers if the initiators share their findings so that other science centers can quote the findings to substantiate their own cases. It is also beneficial for science centers to share the methodology they use for their research so that the results of several studies can be combined to make a stronger case for science centers as a whole.

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Appendix

Request for reports, published studies and unpublished studies that show the impact of science centers / museums on their surrounding communities. 12 July 2001

Dear Colleagues

During June you should have received an email from Per-Edvin Persson (Pelle) telling you about a study of the impact of science centres on their surrounding communities. The idea for the study was initiated by a small group of science center CEOs and supported by the Boards of ASTC and ECSITE. In response to Pelle's invitation, a number of individual science centres have each paid US$2,500 to employ me to do this research.

I am writing to introduce myself, Robin Garnett. I am running the project from Questacon - The National Science and Technology which is located in Canberra, Australia. Annie Ghislaberti, the Director of Questacon, is my immediate supervisor.

The aims of the project are threefold:
1. To collect and collate international reports and studies on the role played by science centres in their communitites.
2. To summarise and present these studies in a useful, accessible way.
3. To identify gaps in the studies.

I shall present a preliminary report for dicussion at the Third Science Centre World Congress to be held in Canberra from 10 - 14 February 2002. This will be followed by a full report which I will send to all science centres that have contributed financially to the project - five copies to each. All institutions that send research studies will receive an email summary of my preliminary and final report.

If you would like to become a financial contributor to the project, you may contact Per-Edwin Persson (pelle@heureka.fi) or Annie Ghislaberti (aghisalberti@questacon.edu.au.

INFORMATION REQUESTED FROM YOUR SCIENCE CENTRE / MUSEUM

STUDIES AND REPORTS
I would be very grateful if you would send me as many studies and as much information as you can for this initial, data-gathering stage of the project. I am particularly asking for material stemming from research in your institution but if you know of useful studies from other members or non-members of ASTC and ECSITE, please let me know.

The reports, published studies or unpublished studies I am looking for have some or all of these characteristics:

* They include quantitive or qualititive data about the influence of your institution on your visitors (or non-visitors)
    - their learning

- their attitude to science
- their subjects studied at school primary / secondary / post-school
- their grades
- their creativity / innovation / projects
- their career choices
- their family leisure patterns
- teachers' pedagogy
- other relevant factors

* They include quantitive or qualitive data on the effect of your institution on your surrounding community, local / national / international

- the media coverage: TV, radio, internet, print, other ..
- social structures and processes
- community groups, clubs, societies
- other institutions
- tourism: visitors / programs / transport
- built and natural environment

I am especially interested in studies that are relevant to science centre CEOs in justifying, positioning, decision-making, selling, competing, influencing and benchmarking their institutions in relation to their external stakeholders.

The study is NOT concerned with:

* the evaluation of particular programs, exhibits or exhibitions that are specific to your institution.

CONTACT DETAILS

Please send me contact details for the people in your institution who:

1. Have / are carrying out studies that are useful for the project
2. Are responsible for profiling your institution to its external stakeholders

The project has a short time frame so please email information to me, Robin Garnett rgarnett@questacon.edu.au

AS SOON AS POSSIBLE so that I can use my time with maximum efficiency.

Or send hard copy to Robin Garnett, Questacon, PO Box E 28, Kingston, Canberra 2607. Again, I would appreciate that material as soon as possible.

With many thanks

Robin

Robin Garnett, International Research Coordinator, Questacon, Australia