Education and Skills Development

# Science Engagement Framework and Youth into Science Strategy: Science Centre Capacity Building Project Evaluation

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# Science Engagement Framework and Youth into Science and Strategy:

# Science Centre Capacity Building Project Evaluation

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Sylvia Hannan
Vijay Reddy
Andrea Juan
Fabian Arends

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## Abbreviations

| | | |
|---|---|---|
| CSIR | - | Council for Scientific and Industrial Research |
| CPAS | - | Centre for the Public Awareness of Science |
| D Ed | - | Doctor of Education |
| DST | - | Department of Science and Technology |
| FET | - | Further Education and Training |
| HartRAO | - | Hartebeesthoek Radio Astronomy Observatory |
| HSRC | - | Human Sciences Research Council |
| ICT | - | Information and Communication Technology |
| MBL | - | Master of Business Leadership |
| NECSA | - | South African Nuclear Energy Corporation |
| NQF | - | National Qualifications Framework |
| PGCE | - | Post-Graduate Certificate in Education |
| PhD | - | Doctor of Philosophy |
| SAAO | - | South African Astronomical Observatory |
| SAASTA | - | South African Agency for Science and Technology Advancement |
| SAASTEC | - | Southern African Association of Science and Technology Centres |
| SANSA | - | South African National Space Agency |
| SCCB | - | Science Centre Capacity Building |
| TLM | - | Teacher Learner Manuals |
| UKZN | - | University of KwaZulu-Natal |
| USA | - | United States of America |

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## Executive summary

The Science Centre Capacity Building (SCCB) project was introduced in response to the capacity challenge presented by the rapid increase in the number of South African Science Centres. The South African Agency for Science and Technology Advancement (SAASTA) was mandated by the Department of Science and Technology (DST) to address capacity building through the provision of training to support science centre officials in improving the effective management of their centres, as well as providing networking and information sharing opportunities.

This study evaluated the training which took place as part of the SCCB project between 2009 and 2014. A range of workshops were conducted between 2009 and 2014, as well as job shadowing and study visits to France and Miami, USA.

Data collection for the study occurred in three phases. Initially reports, attendance registers and information regarding the various workshops were collected (phase 1). Phase 2 involved the collection of data through questionnaires, and phase 3 utilised an online survey as a data collection tool. In both phase 2 and phase 3, respondents were asked questions related to the impact of the SCCB training which they had participated in.

These training opportunities have had an important impact on the capacity of the science centre staff members that have been able to attend the workshops, or taken part in job shadowing or international study visits. The findings of the study highlighted that almost ninety percent of the respondents felt that the training had resulted in a fair to substantial improvement in their capacity for their jobs. In addition, 97% of the responses indicated that staff members are better able to handle various aspects of the identified intervention areas to some extent due to the training. It was also found that in most cases, enabling environments exist at the science centres, which encourage the transfer of knowledge which is gained, as well as its practical implementation. Many managers and staff members emphasised that they would like to attend further training.

The findings of the study informed a number of recommendations which will enhance the impact of the SCCB training and the capacity of science centres. The extent of the training should be increased to incorporate more workshops, or more participants in each workshop, as well as through providing the material covered in the workshop to those who were not able to attend. Training should also be targeted at the specific roles of participants at the science centres; and those areas which are the most problematic should be focused on, with core modules being presented on a yearly basis. Science centres should therefore be consulted regularly to determine the most necessary and relevant training. The transfer of knowledge from those who have attended the training is a further crucial element, and this needs to be encouraged. In addition, it is important to implement strategies which will promote the retention of human capacity within the science centre network.

# Part One: South Africa's Science Centre Network

## 1.1. Introduction

The growing public interest in science centres, and the support which they received from government and the private sector, resulted in an increase in their number in South Africa. The rapid pace of this growth presented a capacity challenge in terms of their management and sustainability. The Department of Science and Technology (DST) consequently identified capacity building among science centres as necessary, and imitated the Science Centre Capacity Building (SCCB) Programme in 2005/06. This programme seeks to address capacity building through the provision of training to support science centre officials in improving the effective management of their centres, as well as providing networking and information sharing opportunities. The South African Agency for Science and Technology Advancement (SAASTA)[1] was subsequently tasked with implementing the project to capacitate the human resources in the existing science and technology centres. The target audience of the SCCB project is science centre staff, science outreach programmes from National Facilities, and science outreach staff from Institutions of Higher Learning (SAASTA, 2009c; SAASTA, 2012b; SAASTA, 2013b).

The purpose of this study was to evaluate the training which has been provided through the SCCB project between 2009 and 2014, in order to determine its impact on the capacity of South Africa's science centres. This report presents the findings of the study from secondary data, including reports and attendance registers, as well as from questionnaires and an online survey completed by the managers and staff of the science centres and institutions relating to the SCCB project training. The first part of this report examines the nature, purpose and importance of science centres. This is followed by information on the location and characteristics of the science centres and institutions in South Africa. Part two of the report discusses the SCCB project and the intervention areas which it addresses, while the third part describes the research questions and the methodology which was used to evaluate the training. Thereafter, the findings of each of the three phases of data collection are presented in parts four, five and six. The report concludes with a number of recommendations related to the findings which emerged from the study.

## 1.2. Science centres and capacity

A science centre can be defined as "a permanently established education facility that provides an interactive educational experience through the use of interactive science, technology, engineering and mathematics exhibits, displays and programmes" (Department of Science and Technology, 2005: 9). These centres incorporate "…exhibits that embody a mix of scientific knowledge and science-based technology" (Tlili, 2008: 131); and attempt to show the relevance of science to everyday life (Rix and McSorley, 1999), with the goal of inspiring individuals to engage with science and technology (Meisner *et al*, 2007). Due to the potential they possess to promote science and technology, it is important that these science centres have the capacity to adequately accomplish these goals.

[1] SAASTA is a business unit of the National Research Foundation (NRF) and the key South African institution for promoting science (SAASTA, 2009c).

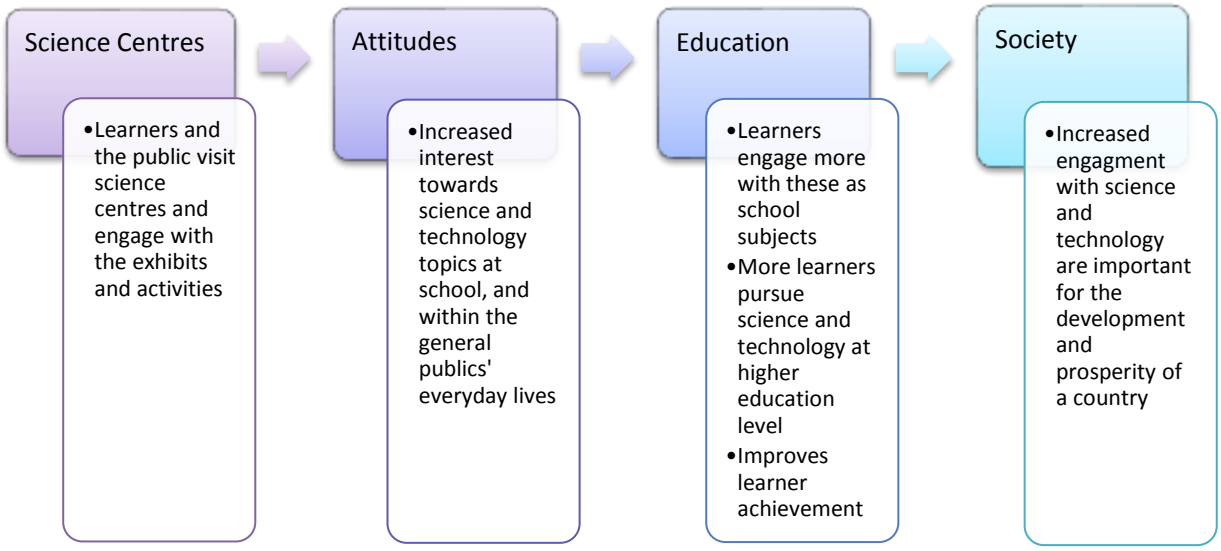
Capacity building or development therefore becomes crucial for the success of these centres, and can be defined as "the process by which individuals, groups, organizations, institutions and societies increase their abilities to: (a) perform core functions, solve problems, define and achieve objectives; and (b) understand and deal with their development needs in a broad context and a sustainable manner" (International Institute for Educational Planning, 2006: 1). The SCCB project therefore has an important role to play in building the capacity of South African science centres to ensure they are able to meet these objectives.

## 1.3. Importance of science centres for learners and the public

Learners' engagement with science centres has been found to positively influence the learning of scientific knowledge, and scientific skills and processes. The largest gains however are made in the influence which science centres have on the development of positive attitudes towards science, which may also result in an increase in the learner's interest and enthusiasm for their everyday science lessons (Rix and McSorley, 1999). More positive attitudes towards science may in turn lead to improvements in learners' achievement (Juan *et al*, 2014).

Science centres have also been identified as an important resource in encouraging the youth to pursue science and technology at the higher education level (Fors, 2006). This has important implications for society as there has been a lack of learners choosing to continue science in the final years of their secondary education and thereafter (Fors, 2006; George, 2006; Mji and Makgato, 2006; Sarjou *et al*, 2012). This is also the case in South Africa where many students perform poorly in science, and therefore do not choose to continue with it, or may not qualify to study science at university (Mji and Makgato, 2006; Martin *et al*, 2012). These centres also play a role in improving the understanding and interest of the public in science and technology. These aspects are important for the development and future prosperity of a country (Fors, 2006). Figure 1 illustrates the significant impact which science centres may have.

**Figure 1: The potential impact of science centres**



## 1.4. Science centres in South Africa

The former South African Minister of Science and Technology, Naledi Pandor, noted that science centres have the potential to help the youth reach their full potential in an informal learning environment, and to promote science awareness; while also playing a role in teacher empowerment, and in showing teachers how to make their subjects more interesting to learners. Science centres also contribute to encouraging the youth to pursue careers in science and technology (Hweshe, 2011; Pandor, 2011).

The aim to increase the number of science centres in the country was announced at the 6th Science Centre World Congress in Cape Town in 2011 (www.southafrica.info). This resulted in the number of science centres increasing from 26 centres in eight provinces in 2011 (Hweshe, 2011) to 34 science centres in nine provinces in 2014. There are 9 science centres in Gauteng, 6 in KwaZulu-Natal, 5 in Western Cape, 4 in Mpumalanga, 4 in Limpopo, 2 in Eastern Cape, 2 in North West Province, and 1 each in Northern Cape and Free State. Figure 2[2] shows the location of each of the 34 science centres in the country, and Table 1 provides the key for the map.

[2] The KZN Science Centre is in the process of moving location, but they are currently using an interim office space. The location shown on the map therefore corresponds to their previous premises at the Gateway Shopping Centre.

**Figure 2: Map showing the location of the science centres in South Africa**

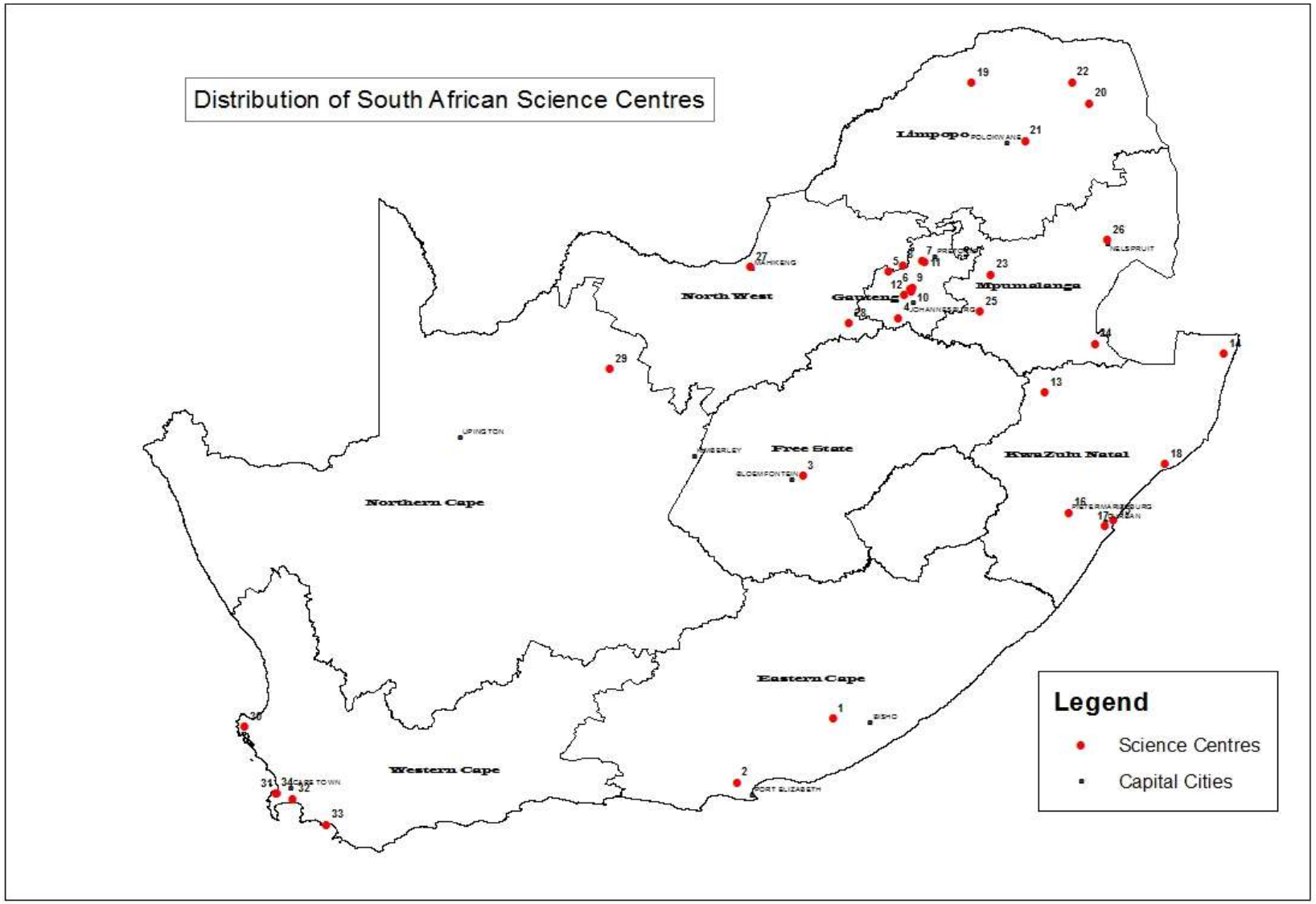


**Table 1: Key for Figure 2**

| Science centre distribution | | | |
|---|---|---|---|
| **1** | FOSST Discovery Centre | **18** | Unizulu Science Centre |
| **2** | Nelson Mandela Bay Science and Technology Centre | **19** | Bostec Science Centre |
| **3** | Boyden Observatory Science Centre | **20** | Giyani Science Centre |
| **4** | Arcelor Mittal Science Centre Sebokeng | **21** | University of Limpopo Science Centre |
| **5** | HartRao | **22** | Vuwani Science Resource Centre |
| **6** | Johannesburg Botanical Gardens Science Centre (Johannesburg City Parks) | **23** | Anglo-American Science, Career Guidance and ICT resource centre |
| **7** | National Zoological Gardens | **24** | Mondi Science, Career Guidance and FET Skills Centre |
| **8** | NECSA Visitor Centre | **25** | Osizweni Education and Development Centre |
| **9** | Sasol Inzalo Foundation | **26** | Penreach Science and Education Centre |
| **10** | Sci-Bono Discovery Centre | **27** | North-West University Mafikeng Science Centre |
| **11** | Sci-Enza | **28** | North-West University Science Centre Potchefstroom |
| **12** | Soweto Science Centre | **29** | Mothibistad Science Centre |
| **13** | Arcelor Mittal Science Centre Newcastle | **30** | Arcelor Mittal Science Centre Saldanha |
| **14** | Isibusiso Esihle Science Discovery Centre | **31** | Cape Town Science Centre |
| **15** | KZN Science Centre | **32** | iThemba Labs |
| **16** | Olwazini Discovery Centre | **33** | SANSA Science Centre |
| **17** | University of KZN Science and Technology Centre | **34** | South African Astronomical Observatory |

## 1.5. Ownership or main funders of South African science centres

The science centres in South Africa have an array of ownership and funding arrangements. It is important to examine these, as it highlights what arrangements are the most prevalent in the country, as well as providing an indication of the capabilities and opportunities which these centres have. Table 2 shows the number of science centres by each type of ownership or main funder. Science centres associated with universities are the most common, with 10 of the 34 centres displaying this arrangement; and community owned or funded centres are the least common, with only 2 science centres exhibiting this arrangement. This may be a reflection of the resources and knowledge which are available to the different types of owners or funders.

**Table 2: Number of science centres by ownership or main funder**

| Ownership or main funder | Number of science centres |
|---|---|
| **National Facility** | 6 |
| **Provincial government** | 5 |
| **University** | 10 |
| **Corporate** | 5 |
| **Community** | 2 |
| **Independent** | 6 |

## 1.6. Problems experienced by the science centres

In order to determine the type of training which needs to be conducted, it is necessary to identify the areas of science centre management which require attention. This was done in the SCCB project through the identification of a number of problems which science centres are faced with. These problems, which were highlighted by the DST in the Terms of Reference, are shown in Figure 3 (DST, n.d.).

**Figure 3: Problems experienced within science centres**

- Poor financial management practices
- Difficulty in submitting project proposals for Programmatic Support Grant Interventions from DST
- Difficulty in developing proposals for National Science Week to DST
- Low level of collaboration with local science centres
- Low level of collaboration with international science centres
- Communities not aware of the existence and role of the centre
- Difficulty in planning and executing projects within the set timeframes
- Difficulty in planning and executing projects within budget
- Difficulty in planning and executing projects in conformance with project objectives
- Lack of skills among staff to conceptualise, design and build own exhibits

The following chapter of the report examines the response to the problems which emerged through the SCCB project and the training which has been provided.

# Part Two: Science Centre Capacity Building Project

The Science Centre Capacity Building (SCCB) project was implemented by SAASTA in 2005/2006, and has involved a number of training workshops, international study visits and a job shadowing programme since this time. The purpose of these interventions has been to improve the management of the centres through capacity building, and to provide opportunities for networking and the sharing of information.

## 2.1. Intended intervention areas of the SCCB project

The main aims of the SCCB project are:

- To provide skills and knowledge development within the science centre network
- To address South Africa's immediate need to attain scientific and technological self-resilience

The specific objectives of the SCCB project are:

- Support capacity building of science centre staff at a national level
- Support the development of capacity building for exhibit development
- Liaison with stakeholders from DST and the Science Centre Council

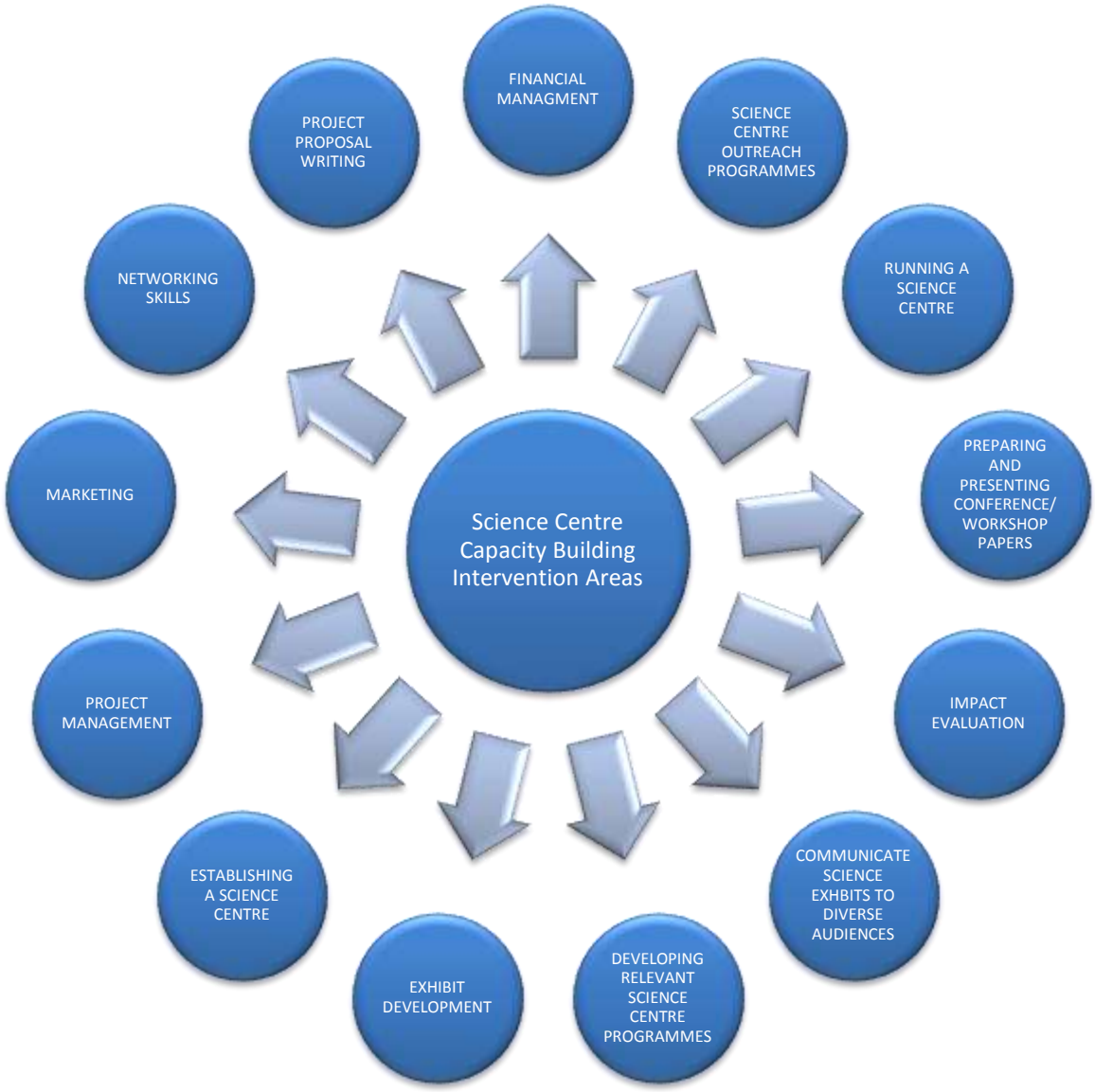
The expected outcomes of the SCCB project are:

- Developed and enhanced core skills of participants
- Developed exhibit prototypes
- Improved programmes at science centres
- Increased networking amongst science centres
- Increased local and international networking opportunities for participants from science centres

(SAASTA, 2009b).

Thirteen intervention areas were identified for the SCCB training to focus on in order to achieve a number of defined outcomes. These areas were initially determined based on the findings of a 2004 feasibility study on science centres; informal discussions with the science centre community, including the leadership of the Southern African Association of Science and Technology Centres (SAASTEC); and shortcomings which DST identified in its interaction with the centres. A 2007 internal implementation evaluation of the SCCB Programme by DST reconfirmed and expanded these areas for skills enhancement (DST, n.d.). The intended intervention areas are shown in Figure 4.

**Figure 4: Intended intervention areas of the SCCB training**

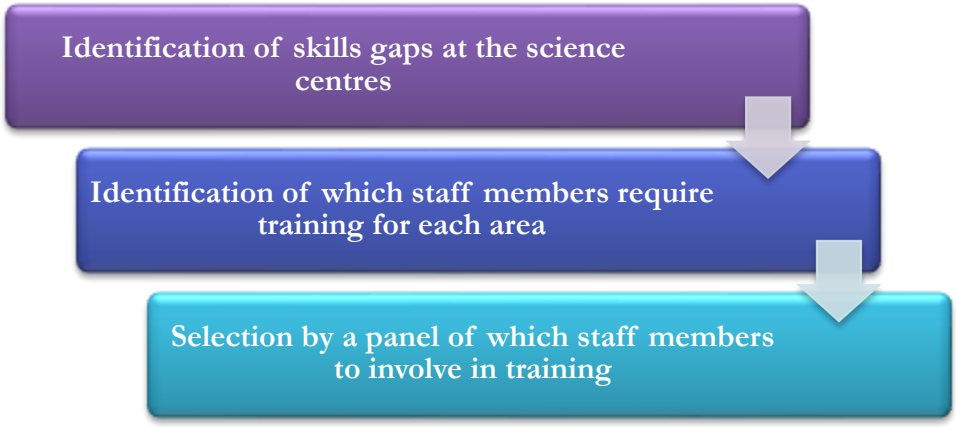



(DST, n.d.).

## 2.2. SCCB Training

The training which has been provided by SAASTA was determined based on the requirements of science centre staff members in terms of their personal development plans. Skills gaps at the science centres were identified in order to determine what training was required, following which staff members who required training in these particular skills were identified. Thereafter, a panel was responsible for the selection of some of these staff members to be involved in the training workshops. The process of identifying skills gaps is therefore a highly collaborative one between the science centres and SAASTA. Figure 5 presents the path that was followed in the determination of the specific training workshops.

**Figure 5: Process by which training is determined by DST and SAASTA**




## 2.3. SCCB Funding

Funding for the SCCB project is provided by the DST, and has increased from R450 000 for the 2009/2010 financial year to R800 000 in the 2014/2015 financial year. Table 3 shows the amount which has been allocated to the SCCB project annually from 2009-2015.

**Table 3: Funding for the SCCB project: 2009-2015**

| Financial Year | Amount |
|---|---|
| **2009/2010** | R 450 000 |
| **2010/2011** | R 450 000 |
| **2011/2012** | R 500 000 |
| **2012/2013** | R 500 000 |
| **2013/2014** | R 600 000 |
| **2014/2015** | R 800 000 |

The following part of the report presents the research questions which informed the focus of the study, and the methodology which was used to answer these questions.

# Part Three: Research Questions and Methodology

## 3.1. Key research questions

The broad research objective is to evaluate the impact of the capacity building training on South African Science Centres. The key research questions are:

1. What training has occurred?
2. What problems are experienced in the management of science centres?
3. Has the training which has occurred had an impact on the capacity of the science centre staff?
4. Has the training which has occurred had an impact on the capacity of science centres?
5. Is there a requirement for further training at the science centres?
6. How can the SCCB training be improved?

## 3.2. Methodology

This study used a summative evaluation approach to assess the quality and success of the SCCB project in reaching its stated goals. It focused on the evaluation of training which was conducted as part of the Science Centre Capacity Building project within South African Science Centres, between 2009 and 2014. "Science centres" was used to encompass the science centres, National Facilities and the Institutions of Higher Learning (outreach) which have participated in the training. The focus was on the impact of the training on staff members, as well as on the science centres as a whole.

The proposed sample consisted of 34 science centre managers. The list of these centres was provided to the Human Sciences Research Council (HSRC) by the DST, and an updated list was provided by SAASTA. In addition, the proposed sample included two staff members from each science centre (68 in total) who had attended the various training workshops. The respondent sample consisted of 24 science centre managers (71% response rate) and 26 staff members (38% response rate), as six of the science centres were unable to complete the required questionnaires due to neither the current managers nor staff members having attended any of the relevant training. Four other science centres did not complete any of the questionnaires.

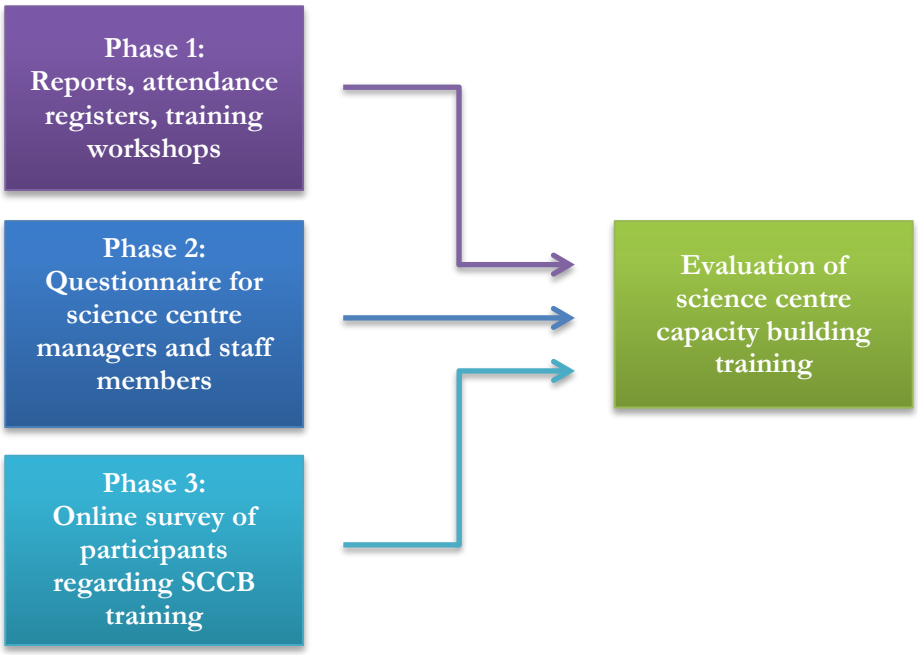
The collection of data proceeded in three phases. Initially, reports on the SCCB were collected, as well as a list of the workshops which had been held. Attendance registers for some of the workshops, and lists of science centre staff members that presented at the annual Southern African Association of Science and Technology Centres (SAASTEC) Conference, as well as at the 2011 Science Centre World Congress held in Cape Town, were also gathered.

Questionnaires were then designed for science centre managers and science centre staff based on the intended intervention areas and the training which had been held. The second phase of data collection therefore involved science centre managers from each of the 34 science centres, who were asked to complete a questionnaire providing information about their science centre, the problems which they experience and aspects of the training. The contact details for the science centre managers were provided by SAASTA. Staff members of the science centres who attended the various workshops, participated in job shadowing, or international study visits or training,

were also asked to complete questionnaires related to the specific intervention areas which were addressed in the training they attended. These staff members were identified by the science centre managers based on the training which they had participated in.

In the third phase of data collection, a survey was created using an online survey programme. Some of the participants of the training (126) were then contacted via e-mail and asked to complete the online survey. Attendance registers from some of the workshops, which were attained from SAASTA, provided their contact details. Of these, 12 had incorrect e-mail addresses, two were no longer at the centres, and one was a presenter rather than a participant. Therefore 111 participants remained, and out of these, 73 participants responded to the survey (66% response rate). The questions which were asked sought to gain a more in depth perspective of the training and the impact which it had on the capacity of participants, as well as its impact on the science centres. This phase focused on workshops which took place between 2011 and 2014. Figure 6 provides an outline of the phases of data collection.

**Figure 6: Phases of the data collection**




Each of the phases of data collection focused on different information, while phases 2 and 3 contained a number of similar questions. Phase 1 of the data collection addressed the first research questions regarding what training has occurred. Phase 2 covered the rest of the research questions, focusing on training which occurred between 2009 and 2013. Phase 3 addressed questions three, four, and six; and focused on the period 2011 to 2014, while including some more in depth questions.

Parts four, five and six of the report present the results of the data collection. The SCCB training which occurred between 2009 and 2014 is discussed in part four, part five explores the findings from the science centre questionnaires, and part six presents the findings from the online survey.

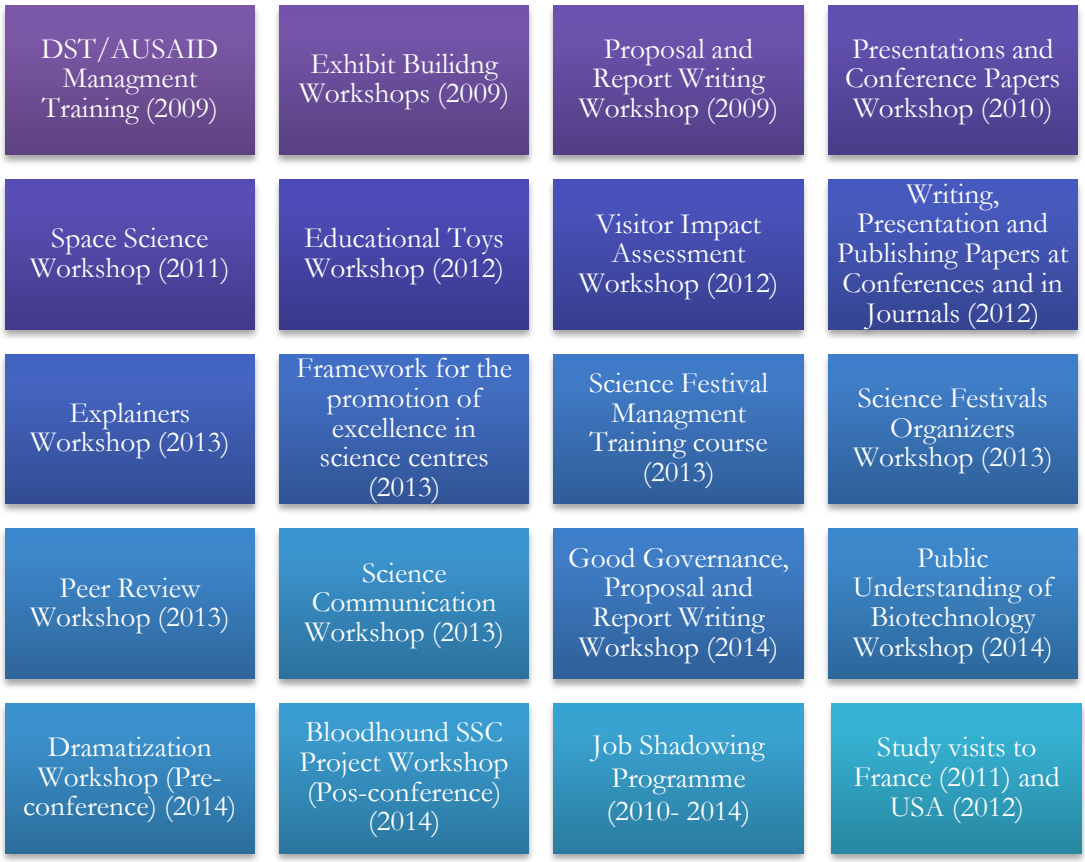
# Part Four: Findings from Phase 1

This section presents the SCCB training which occurred between 2009 and 2014 in terms of the workshops which were held, what they addressed and how many people attended the training. The presentations of science centre staff members at the SAASTEC Conferences and the 6th Science Centre World Congress held in South Africa in 2011 are also highlighted.

## 4.1. What capacity building training has occurred?

Figure 7 shows the training workshops which were held between 2009 and 2014, as well as the Job Shadowing Programme which is on-going, and international study visits to France in 2011 and Miami, USA in 2012. Further workshops are being held during 2015; however these are not covered in the study, as the period of investigation ended in 2014.

**Figure 7: SCCB Training (2009-2014)**




### 4.1.1. DST/AUSAID Management Training

DST and SAASTA partnered with the Australian National University through the Centre for the Public Awareness of Science (CPAS) to provide training to potential science centre managers, in order to increase the pool of future science centre managers. A two week workshop was held in South Africa in 2009, and was attended by 25 participants that were selected by a panel: 20 from South Africa and 5 from Lesotho (SAASTA, 2009a; SAASTA, 2009c). The workshop was held at Sci-Bono Discovery Science Centre in Johannesburg, and covered a variety of focus areas which included starting a science centre, running a science centre, implementing science centre

outreach programmes, assessing the impact of a science centre, strengthening networks (locally and internationally), exhibition development and how to propose and prepare conference paper/ sponsorship proposals. The participants were asked to evaluate the training, and all of them stated that they enjoyed it and would like more workshops of that nature to be held (SAASTA, 2009c).

For phase 2 of the training, nine of the best communicators from South Africa and Lesotho were selected to go to Australia to undertake a Graduate Certificate in the Theory and Practice of Science Centres at CPAS through a ten week course. As part of the course, the participants spent two weeks at the Questacon science and technology centre working alongside exhibition designers and planners. This training therefore provided a professional qualification, as well as practical experience to those who took part (SAASTA, 2009a). Five of the participants remain in the science centre network, four of them as managers of science centres. Two of the other participants also remain at their institutions, one at DST and one at SAASTA.

#### 4.1.2. Exhibit Building Workshops

Exhibit building workshops were held at three venues, in Gauteng, KwaZulu-Natal and the Western Cape in 2009. The objectives of these workshops were to teach delegates conceptualisation and design skills for exhibits; enhance tool and material skills of participants; and for the participants to design, construct and evaluate a science centre exhibit. The workshops were also responsible for promoting increased networking among science centre staff (SAASTA, 2009b), and the exhibits which were developed were left at the host centres for their use (SAASTA, 2009a).

#### 4.1.3. Proposal and Report Writing Workshop

This workshop was conducted in 2009, and was attended by 47 science centre staff members from 22 science centres. According to Shadrack Mkansi, Manager of SAASTA's science awareness unit, participants submitted proposals soon after the workshop, and these showed a significant improvement from those proposals that had been received previously (SAASTA, 2009a); indicating a level of success from this workshop.

#### 4.1.4. Presentations and Conference Papers Workshop

The Presentations and Conference Papers Workshop was held in Gauteng and the Western Cape in July 2010. The purpose of the workshop was to equip the staff of the science centres with the necessary presentation skills for conferences, as well as assisting them in preparing for the Science Centre World Congress which was hosted in South Africa in 2011 (SAASTA, 2011a). The workshop was attended by 39 participants, and approximately 17 of these participants subsequently presented papers at the 11$^{th}$ SAASTEC Conference in 2010 (SAASTA, 2011a; SAASTEC, 2010).

#### 4.1.5. Space Science Workshop

The Space Science Workshop was presented by the Space Science and Technology Sub-programme, together with the South African National Space Agency (SANSA) Operation, as basic space science and technology training. This was to enable staff to expose visitors at the science centres to the benefits of space science and technology in their everyday lives. The

workshop took place over two days at SANSA in 2011, and 25 participants from 17 science centres were involved. The feedback from the workshop participants was positive, and many stated they would participate in another workshop of that nature (SAASTA, 2012b).

#### 4.1.6. Educational Toys Workshop

This workshop was held at the Johannesburg Observatory on the 20 and 21 September 2012, and focused on the manufacturing and designing of educational toys. It was attended by 35 participants from various science centres, ranging from volunteers to managers. The workshop was based on objectives defined by DST and SAASTA, which were: to use readily available items to make low cost Teacher Learner Manuals (TLMs) and educational toys; to train staff to handle tools and utensils safely and effectively; to realise fundamental machine mechanisms, structure, balance and harmonies; and to design and conduct science activities using limited tools and materials ((SAASTA, 2013a; SAASTA, 2013b). It was presented by a Japanese volunteer at the Osizweni Education and Development Centre in Mpumalanga, and received favourable feedback from the participants (SAASTA, 2013a).

#### 4.1.7. Visitor Impact Assessment Workshop

The Visitor Impact Assessment Workshop showed science centre staff members how to conduct impact assessments related to their facilities, programme and activities. It therefore covered aspects such as visitor research methods, principles of exhibit evaluation and understanding the experience of visitors. It was held on the 25 and 26 November 2012, and had 46 participants.

#### 4.1.8. Writing, Presentation and Publishing Papers at Conferences and in Journals Workshop

The overall aim of the workshop was to increase the number of science centre staff presenting papers at conferences. The workshop covered aspects such as researching for a conference or workshop paper; writing an abstract; writing a paper; presenting a paper and handling the question and answers session at a conference. It was held on the 7 and 8 August 2012, and was attended by all 30 invited participants. The feedback which was provided concerning the workshop was positive (SAASTA, 2013b). The training resulted in a number of papers and posters being presented at the 2013 SAASTEC Conference, and at the Science Centre World Summit which was held in Belgium from the 17 to 19 March 2014.

#### 4.1.9. Explainers Workshop

The Explainers Workshop was based on teaching participants how to explain the science and technology behind their exhibits, and how to make it more interesting to learners and the public. It was held on the 28 February 2013, with 34 participants from science centres, and four from SAASTA. Participants were satisfied with the training and there were requests for the workshop to be repeated at other centres (SAASTA, 2013b).

#### 4.1.10. Framework for the promotion of excellence in science centres

This was a forum for discussion rather than a workshop, and was attended by 32 people in 2013. Participants from the science centres engaged with one another by sharing their experiences and learning best practices from one another, thereby enhancing the promotion of excellence in science centres.

#### 4.1.11. Science Festival Management Training Course

The Science Festival Management Training Course took place from the 16-19 March 2013, during Scifest Africa. Fifteen participants from coastal science centres were chosen to attend the training (SAASTA, 2013b). The workshop focused on training science centre staff members on the organisation and management of science festivals. This included the sharing of educational resources, experiences and best practices; an intensive training programme on organising and managing science festivals; the use of the centre's background and local resources to organise festivals; and the effective use of science models for outreach purposes.

#### 4.1.12. Science Festivals Organizers Workshop

The Science Festival Organizers Workshop was attended by 33 people, and was held from the 4-6 September 2013. The workshop covered the same topics as the Science Festival Management Training Course, but was held for inland science centres.

#### 4.1.13. Peer Review Workshop

The Peer Review Workshop was held on the 5 July 2013, and was attended by 36 participants. It involved the engagement of science centre staff with one another in order to share experiences and learn best practices from one another, thereby promoting excellence in science centres. The workshop included concepts such as understanding the framework for promotion of excellence in science centres; conducting an individual review of a centre; compiling the data in the website for the science centre database, and using tools for review.

#### 4.1.14. Science Communication Workshop

Forty three participants took part in the Science Communication Workshop in 2013. This workshop aimed at providing delegates with knowledge and understanding of best practice principles in science communication. Participants were given the opportunity to explore existing and innovative approaches to science communication, including the use of social media platforms, science cafes, media round tables and communication through radio and television. The workshops therefore also aimed to equip the delegates with practical science communication skills and confidence.

#### 4.1.15. Good Governance, Proposal and Report Writing Workshop

This workshop was held on the 18 and 19 September 2014, and had 33 participants. The focus of the workshop was on proposal writing for DST/SAASTA and other sponsors, as well as the reporting format required for audit purposes. Participants were also taught about proper and interesting fundraising techniques, and good governance was examined in terms of legislation which has an impact on science centre management.

#### 4.1.16. Public Understanding of Biotechnology Workshop

Thirty people attended this workshop which took place on the 14 and 15 October 2014. Biotechnology was examined in the workshop, in relation to biofuels as an alternative energy product. Enhancing the understanding of biotechnology is important in order to promote awareness, dialogue and debate surrounding these issues.

### 4.1.17. Dramatization Workshop (Pre-Conference)

The Dramatization Workshop was conducted prior to the 2014 SAASTEC Conference, which was held from the 18 to 20 November. The workshop therefore took place on the 16 and 17 November, and was attended by 55 participants. The use of dramarization as a means of communicating elements of science and technology to audiences, through personalising and acting out science, was explored in this workshop.

### 4.1.18. Bloodhound SSC Project Workshop (Post-Conference)

The SAASTEC post-conference workshop was held on the 21 November 2014, with 48 participants. The workshop explored the Bloodhound Supersonic Car (SSC), which is a jet-and-rocket-powered car which will attempt to break the land-speed record in Hakskeenpan in the Northern Cape in 2015 and 2016 (www.saasta.ac.za b). The key objective of the Bloodhound SSC project involves inspiring the generation of scientists and engineers by sharing the excitement, and engaging educators and families. Science centres, as SAASTA's main stakeholders, have been given the opportunity to participate in the project through engaging in science communication and running competitions linked to the project.

### 4.1.19. Job Shadowing Programme

The Job Shadowing Programme is an on-going programme which provides science centre staff with the opportunity to visit and learn from other science centres. The programme therefore focuses on providing personal experiential learning for developing skills, and allows staff to share and learn best practices from local centres. This consequently increase the number of skilled science centre staff in South Africa. A number of centres have participated as host institutions, allowing staff from other centres to learn from them. The programme addresses aspects such as the overall management of a science centre; conceptualisation and implementation of onsite and outreach programmes; booking systems; the development, maintenance and funding of exhibits; monitoring and evaluation of activities; marketing and communication; infrastructure requirements; and fundraising and/or sponsorship. Science centres are satisfied with the programme and would like it to continue (SAASTA, 2011b; SAASTA, 2013b). In total, 104 people benefited from the Job Shadowing Programme between 2010 and 2014.

### 4.1.20. Study visit to France

Puleng Tsie, originally from Sci-Enza (now at ArcelorMittal Newcastle) was awarded a study visit to France by the French Department of Culture, through a professional exchange programme with South Africa. This visit was funded by the DST, and was for a two month period between 18 August and 23 October 2011 (SAASTA, 2011c; SAASTA, 2012b; www.saasta.ac.za a).

### 4.1.21. Miami, USA visit

SAASTA, in collaboration with Miami University and the Miami Science Museum, through DST sponsored four science centre managers and staff members (Candice Potgieter, KZN Science Centre; Elize de Jager, NZG; Irene Schoeman, Sci-Enza; and Norman Mthembi, Giyani Science Centre) and SAASTA's Science Awareness Manager, Shadrack Mkansi, to go on a study visit to Miami for 12 days in 2012 to learn more about their science awareness projects. Science centre staff members from around South Africa were invited to submit proposals to SAASTA indicating why they should be selected to participate in this visit, and these five were then

chosen. The tour included visits to places such as the Miami Science Museum and the Miami Zoo. The visit was successful and positive feedback was received (SAASTA, 2012a; SAASTA, 2013b). Science centre staff members have implemented programmes at their centres as a result of the visit, including programmes addressing impact evaluation and outreach programmes (SAASTA, 2013b). Four of the five participants are still employed at their respective institutions.

As shown in the preceding discussion, the various workshops have addressed a range of areas related to science centres, their management and their everyday operation. Table 4 indicates the areas which were addressed by each of the workshops, as well as the number of participants who attended them.

**Table 4: Areas addressed by each workshop and number of participants**

| Workshop | Areas addressed | Number of participants |
|---|---|---|
| **DST/AUSAID Management Training** | Starting, managing and running a science centre | 25 |
| **Exhibit Building Workshops** | Exhibit development: design, construction and evaluation | 44 |
| **Proposal and Report Writing Workshop** | Proposals and report writing | 47 |
| **Presentations and Conference Papers Workshop** | Preparing conference papers<br>Presentation skills | 37 |
| **Space Science Workshop** | Explanation and promotion of space science and technology | 25 |
| **Educational Toys Workshop** | Educational toys development: using limited tools and materials | 35 |
| **Visitor Impact Assessment Workshop** | Conducting impact assessments related to a centre's facilities, programmes and activities | 46 |
| **Writing, Presentation and Publishing Papers at Conferences and in Journals Workshop** | Researching and writing papers, presenting papers; handling question and answer sessions | 30 |
| **Explainers Workshop** | Explanation of science and technology concepts behind the exhibits | 38 |
| **Framework for the promotion of excellence in science centres** | Sharing experiences and best practices for promoting excellence | 32 |
| **Science Festival Management Training Course** | Organisation and management of science festivals | 15 |
| **Science Festivals Organizers Workshop** | Organisation and management of science festivals | 33 |
| **Peer Review Workshop** | Sharing experiences and learning best practices; review of science centres | 36 |
| **Science Communication Workshop** | Best practice principles and methods for science communication | 43 |
| **Good Governance, Proposal and Report Writing Workshop** | Aspects of good governance<br>Writing proposals and reports | 33 |
| **Public Understanding of Biotechnology Workshop** | Public understanding of biotechnology | 30 |
| **Dramatization Workshop** | Dramatization as a tool for communication | 55 |
| **Bloodhound SSC Project Workshop** | The Bloodhound Supersonic Car | 48 |
| **Job Shadowing programme** | Various aspects of science centre management and operation | 104 |

The number of participants for these workshops has ranged from 15 to 55, with 104 science centre staff members having participated in the job shadowing programme between 2010 and 2014.

## 4.2. SAASTEC Conferences and the 6th Science Centre World Congress

A SAASTEC Conference is held annually, and occurs in different locations each year. Science centre managers and staff members participate in these conferences, which incorporate a range of presentations on various topics related to science centres and science in general. A Science Centre World Congress is held every three years, and in 2011 the 6th World Congress was hosted in Cape Town, South Africa. Fifty six participants were funded to attend the congress and pre-congress workshop (SAASTA, 2011c). Table 5 shows how many science centres were represented through presentations and poster presentations annually, and the approximate number of presenters from local science centres at each of the SAASTEC Conferences and at the World Congress (See Appendix 1 for further information).

**Table 5: Number of presenters and science centres represented at the annual SAASTEC Conferences and the 6th Science Centre World Congress**

| Conference | Presenters from local science centres | Number of science centres represented |
|---|---|---|
| **12th SAASTEC Conference** | 35 | 12 |
| **13th SAASTEC Conference** | 47 | 15 |
| **14th SAASTEC Conference** | 49 | 17 |
| **15th SAASTEC Conference** | 48 | 18 |
| **16th SAASTEC Conference** | 66 | 19 |
| **6th Science Centre World Congress** | 32 | 15 |

Although the SAASTEC Conferences do not form part of the SCCB project training, they provide the opportunity for science centre staff members to learn from others, apply what they have learned in the training they have attended, and to network with staff from other science centres and institutions. They therefore play an important role in the capacity building of the science centres' staff members.

# Part Five: Findings from Phase 2

Part five examines the findings from phase 2 of the study, including the identification of problems experienced at the science centres, the quality and relevance of the training for staff members, and the impact of the training which has occurred. It also highlights the most valuable aspects of the training, and the need for further training which was emphasised by the respondents.

## 5.1. The involvement of science centre managers and staff members in training

For phase two of the study, each of the science centre managers were asked to complete a questionnaire. Two staff members were also identified by their managers, based on the training which they had attended, and required to complete a staff questionnaire. However, some of the centres were only able to complete one or two questionnaires. This was the case where the manager was the only staff member, or where staff members that had attended the training had since left the science centres. This was particularly the case in centres where many of the staff members are volunteers, often on one year contracts. Six of the 34 science centres indicated that they could not complete any of the questionnaires as none of the current staff members had attended any of the training workshops or participated in job shadowing up until 2013.

Table 6 indicates the total number of staff members (full time, part time and volunteers) at 30 of the science centres, the number of workshops which were attended by the manager or staff members between 2009 and 2013, and whether or not the manager or any other staff members participated in job shadowing. Four of the science centres did not return their questionnaires, and therefore they are not included in the table. Those science centres whose staff had not attended any of the training are included in the table, but some of the numbers of staff members were not available. These numbers provide an indication of the relative size of each centre.

Table 6: Number of staff members at each science centre, number of workshops attended and participation in job shadowing: 2009-2013

| Science centre | Total number of staff members (2013) | Number of workshops attended by manager | Number of workshops attended by staff members | Total number of different workshops attended | Job shadowing |
|---|---|---|---|---|---|
| **Anglo-American Science, Career Guidance and ICT resource centre[3]** | 13 | 11 | 0 | 11 | Yes |
| **Arcelor Mittal Science Centre Newcastle** | 6 | 8 | 4 | 9 | Yes |
| **Arcelor Mittal Science Centre Saldanha** | 10 | 5 | 1 | 6 | No |
| **Arcelor Mittal Science Centre Sebokeng** | 26 | 8 | 10 | 14 | Yes |
| **Boyden Observatory Science Centre** | 5 | 3 | 1 | 3 | No |
| **Cape Town Science Centre** | 37 | 4 | 9 | 11 | Yes |
| **Giyani Science Centre** | 25 | 3 | 13 | 14 | Yes |
| **HartRAO** | 4 | 0 | 4 | 4 | No |
| **Isibusiso Esihle Science Discovery Centre** | 1 | 0 | 0 | 0 | No |
| **iThemba Labs** | 3 | 0 | 0 | 0 | No |
| **Johannesburg Botanical Gardens Science Centre (Johannesburg City Parks)** | 4 | 5 | 1 | 5 | No |
| **KZN Science Centre** | 19 | 2 | 0 | 2 | |
| **Mondi Science, Career Guidance and FET Skills Centre** | 14 | 8 | 7 | 12 | Yes |
| **Mothibistad Science Centre** | 1 | 6 | 0 | 6 | Yes |
| **National Zoological Gardens** | 23 | 1 | 3 | 4 | No |
| **NECSA Visitor Centre** | 11 | 7 | 3 | 8 | Yes |
| **North West University Science Centre Potchefstroom** | 2 | 7 | 0 | 7 | Yes |
| **North West University Mafikeng Science Centre** | 4 | 4 | 6 | 8 | Yes |
| **Olwazini Discovery Centre** | | 0 | 0 | 0 | No |
| **Osizweni Education and Development Centre** | 7 | 0 | 0 | 0 | No |
| **South African Astronomical Observatory** | 15 | 6 | 9 | 12 | No |
| **SANSA Science Centre** | 3 | 5 | 2 | 7 | Yes |

[3] These numbers were provided by the previous manager of the science centre, who has since left.

| | | | | | |
|---|---|---|---|---|---|
| **Sasol Inzalo Foundation** | | 0 | 0 | 0 | No |
| **Sci-Bono Discovery Centre** | 88 | 4 | 12 | 12 | Yes |
| **Sci-Enza** | 9 | 3 | 1 | 3 | Yes |
| **Soweto Science Centre** | | 0 | 0 | 0 | No |
| **University of KwaZulu-Natal Science and Technology Education Centre** | 1 (and student volunteers) | 5 | 1 | 5 | Yes |
| **University of Limpopo Science Centre** | 14 | 4 | 12 | 14 | Yes |
| **Unizulu Science Centre** | 18 | 1 | 12 | 12 | Yes |
| **Vuwani Science Resource Centre** | 7 (average) | 7 | 6 | 13 | Yes |

The involvement of science centres in the training has been highly variable. A few of the science centres had not been involved in any of the training until 2013, while three science centres had participated in all of the workshops which took place between 2009 and 2013. In some of the centres, the managers had attended most of the training workshops, while staff members only attended a few of them. In other cases, the manager had attended a small number of workshops, while their staff members had been involved in a range of the SCCB training. It is important that training opportunities are provided for as many staff members as possible, although this will depend on the number of staff at each centre. Staff members from seventeen of the science centres had been involved in the Job Shadowing Programme between 2010 and 2013, which is an important indicator, as this provides valuable capacity development and knowledge sharing experiences.

## 5.2. Who were the respondents for phase 2?

The following tables provide the profiles of the respondents from phase 2 of the data collection. Table 7 provides the profiles of the managers who completed the questionnaire and Table 8 shows the profiles of the respondent staff members. All of the staff members who completed the questionnaire were employed on a full time basis.

### Table 7: Profiles of science centre managers

| **Race** | **Percentage of respondents** |
|---|---|
| Black | 52% |
| Coloured | 4% |
| Indian | 8% |
| White | 36% |
| Other | 0% |
| **Sex** | |
| Male | 56% |
| Female | 44% |
| **Age** | |
| Under 25 | 0% |
| 25-35 | 9% |
| 35-45 | 23% |
| 45-55 | 45% |
| 55-65 | 23% |
| 65 and over | 0% |
| **Period as manager**[4] | |
| Less than a year | 8% |
| 1-5 years | 36% |
| 6-10 years | 32% |
| 11-15 years | 8% |
| 20 or more years | 16% |
| **Highest educational qualification** | |
| Diploma | 4% |
| Degree | 12% |
| Post-graduate diploma/certificate | 23% |
| Honours degree | 27% |
| Masters degree | 15% |
| Doctorate | 19% |

[4] This was until 2014 when the data was collected. One of the managers has since left the science centre.

### Table 8: Profiles of science centre staff members

| **Race** | **Percentage of respondents** |
|---|---|
| Black | 72% |
| Coloured | 12% |
| Indian | 8% |
| White | 8% |
| Other | 0% |
| **Sex** | |
| Male | 52% |
| Female | 48% |
| **Age** | |
| Under 25 | 4% |
| 25-35 | 48% |
| 35-45 | 25% |
| 45-55 | 25% |
| 55-65 | 0% |
| 65 and over | 0% |
| **Number of years at the science centre** | |
| Less than 1 year | 4% |
| 1-3 years | 23% |
| 4-6 years | 42% |
| 7-9 years | 19% |
| 10-15 years | 8% |
| More than 20 years | 4% |
| **Position at the time of training** | |
| Education officer/educator/environmental education specialist | 46% |
| Science communicator/science communication specialist | 19% |
| Project co-ordinator | 12% |
| Facilitator | 8% |
| Marketing and events co-coordinator | 4% |
| Deputy manager | 4% |
| Career guidance centre manager | 4% |
| Team leader | 4% |
| Lab technician | 4% |

## 5.3. Problems encountered in the science centres

The science centre managers were asked what problems they have experienced at their centres, as this provides an indication of the areas which may require attention through capacity building. Table 9 shows how many of the science centres indicated that they have experienced each of the problems identified. The table includes two managers who were unable to complete the questionnaire as no staff members had attended training. They did however indicate the problems which they experience at their centres.

**Table 9: Problems experienced by the science centres**

| Problems experienced | Number of science centres |
|---|---|
| **Lack of skills among staff to conceptualise, design and build own exhibits** | 23 |
| **Insufficient staff** | 22 |
| **Low level of collaboration with international science centres** | 19 |
| **Lack of capacity amongst staff** | 18 |
| **Communities not aware of the existence of their centre** | 15 |
| **Difficulty in submitting project proposals for Programmatic Support Grant Interventions from DST** | 15 |
| **Low level of collaboration with local science centres** | 15 |
| **Poor financial management practices** | 11 |
| **Difficulty in undertaking projects within budget** | 10 |
| **Difficulty in developing proposals for National Science Week to SAASTA** | 10 |
| **Difficulty in executing projects within the set timeframes** | 9 |
| **Difficulty in undertaking projects in conformance with project objectives** | 8 |

All of the identified problems were experienced by some of the science centres. The most commonly encountered problems were related to staff: including insufficient staff, lack of capacity amongst staff and a lack of skills among staff to conceptualise, design and build their own exhibits. The problems which were encountered by the least number of science centres included difficulty in executing projects within set timeframes and undertaking projects in conformance with project objectives. The problems of insufficient staff and a lack of capacity amongst staff were further emphasized as major problems for those science centres with only one or a few staff members, as limited staff members are responsible for conducting all of the activities for the science centres. Some science centres rely mainly on volunteers or part time staff, which presents difficulties as new volunteers who lack the necessary skills have to continuously be trained. In these cases, although the volunteers gain valuable experience which assists them in finding jobs and making career decisions, this is not a sustainable long term solution for the centres. It also makes it difficult for science centres to participate in events such as National Science Week, where extensive work has to be done in a short period of time with limited capacity. Furthermore, it is often not possible for these centres to send staff members to training as this leaves the centre with insufficient staff to conduct their regular programmes and activities.

Low levels of collaboration with local science centres and international science centres were also highlighted by over half of the respondents as problems, while fifteen managers noted that communities are not aware of their existence. These problems emphasise the need for a further focus on building the science centre network in the country, encouraging links with international centres and promoting these centres to the public.

Financial sustainability was also highlighted by some science centres as an issue. Some centres noted a lack of funding, and delays in payments due to grants being controlled by external parties. This is a problem as long-term funding is necessary for a sustainable business plan which

affects the management of these centres. The administration load was also identified as problematic, and constraints related to working within university structures were noted. In addition, challenges related to running a science centre, project management, marketing, and the evaluation of programmes, events and exhibits were identified. Some centres also felt they have not had the opportunity to attend training and have been working predominantly independently.

These problems highlight the importance of training, as it addresses the capacity of staff members, thereby leading to improved capacity of the science centres. This enables them to more effectively tackle such problems, and become more efficient in their day to day management.

The following sections present aspects related to the impact which the SCCB training has had on the capacity of science centres and their staff members.

## 5.4. Quality and relevance of the training for staff members

For phase 2 of the data collection, the managers and staff members were given separate questionnaires, and were asked to complete only the sections which related to the intervention areas which were covered by the workshops or job shadowing which they participated in. They were therefore required to only complete the sections of the questionnaires which had been addressed in the training they attended.

Staff members were asked to rate the quality of the training, as well as its relevance to their positions, in terms of each of the intervention areas which were covered in the training they attended. The quality of the training is important as this will have an impact on the extent of learning and knowledge exchange which takes place, and therefore the extent to which capacity building occurs. The relevance of the training is not a reflection of the success of the training, as a workshop may be well run but not particularly relevant to the responsibilities of the staff members who attend. The relevance does however provide an indication of whether the correct staff members are participating in the training workshops. It also gives an idea of whether the training will have an impact on the staff members' capacity, as training which is relevant to their position will have a greater impact on the completion of their everyday responsibilities.

The rating scales ranged from 1 to 5, from "very poor quality" (1) to "very high quality" (5), and from "very irrelevant" (1) to "very relevant" (5). Forty eight responses were recorded for these questions, as some staff members answered questions pertaining to more than one intervention area. Both the quality and the relevance of the training were rated between 3 (neutral) and 5 (very high quality/very relevant) for all of the responses, with no responses rating the training as below 3 for either category. Figures 8 and 9 highlight the percentage of the responses which were given for each level from "neutral" to "very high quality" or "very relevant". For the quality of the training, 86% of the responses rated the training as "high quality" or "very high quality", and 87% rated the relevance of the training for their position as "relevant" or "very relevant". The high quality and relevance of the training therefore indicate that capacity building, through these workshops and job shadowing, is occurring successfully in most cases.

**Figure 8: Quality of the training**

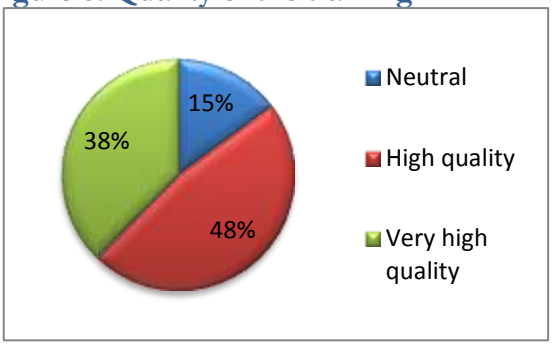
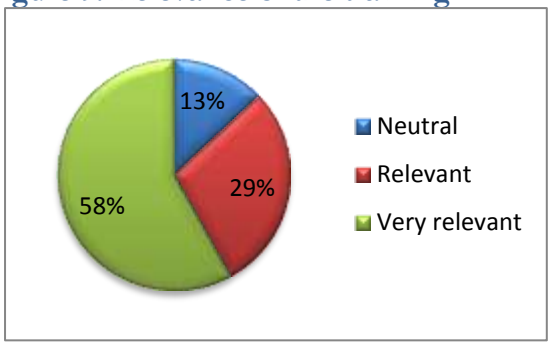



**Figure 9: Relevance of the training**




## 5.5. Changes as a result of the training

There are a number of elements of each of the intervention areas which provide an indication of the specific type of improvements which have occurred as a result of the training. This was elicited through a number of questions which were asked in the questionnaires pertaining to each intervention area, and these are shown in Figure 10.

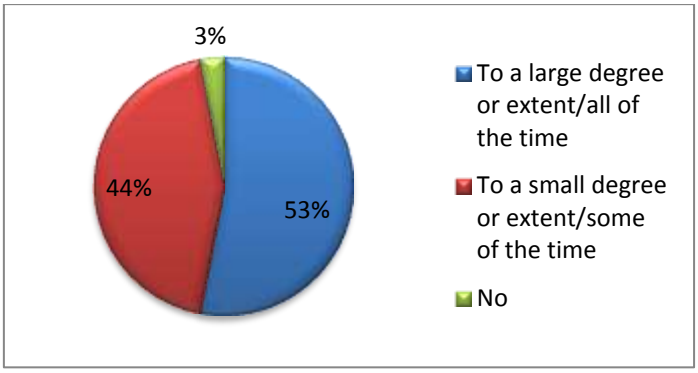
**Figure 10: Aspects of the intervention areas which have improved as a result of the training**

- Better able to address aspects of financial management at their science centre
- Better able to write project proposals
- Better able to network with staff from other science centres
- Better able to address aspects of marketing the science centre
- Better able to manage projects
- Better able to develop exhibits
- Better able to develop relevant science centre programmes
- Better able to communicate science exhibits to diverse audiences
- Better able to communicate sensitive matters to the audience
- Better able to explain the science and technology behind the exhibits in a way that is understandable to all audiences
- Better able to evaluate the impacts of the science centre's programmes and activities
- Better able to prepare conference and workshop papers
- Better able to present conference and workshop papers
- Better able to address aspects of running a science centre
- Better able to manage science centre outreach programmes

Staff members were asked whether they are better able to deal with various aspects of the intervention areas as a result of the training which they attended. Staff members answered different questions depending on what was addressed in the training they took part in, and these responses were therefore combined, with a total of 62 responses to the questions in Figure 10. For all of these questions, the responses included options for "yes, to a large degree or extent/ yes, all of the time", "yes, to a small degree or extent/ yes, some of the time" and "no". Figure 11 indicates the percentage of responses which were received for each category. Ninety seven percent of the responses to these questions indicated that staff members are better able to handle various aspects of the intervention areas to some extent due to the training which has taken

place, with more than half stating that they are better able to do so to a large degree or extent, or all of the time. Only 3% of the responses suggested no benefit from the training.

**Figure 11: Changes which have taken place as a result of the training in terms of staff capacity**




There were also fifteen responses to questions regarding the introduction of new exhibit types, programmes, impact evaluation techniques or outreach programmes by staff members at their respective science centres as a result of the training. About a third of these responses (33%) indicated that staff members had implemented something new after attending the training workshops or job shadowing. These included new exhibit types such as educational toys, experiments, problem solving, posters, videos and games; and new programmes including a recycled toys holiday programme; as well as incorporating many of the activities learned at the Educational Toys Workshop into their workshops, programmes and outreach activities. The new impact evaluation techniques which were implemented included the observation of visitor interaction with exhibits to understand if the science is communicated effectively and clearly, as well as the use of questionnaires for pre- and post-visit assessment. Staff members also noted that they had introduced new outreach programmes through exhibiting at a local mall regularly, conducting outreach during National Science Week, as well as providing curriculum support and introducing programmes about space science and science in a pub.

In order to gain an understanding of the improvements which have taken place in the science centres as a whole, managers were asked a series of questions related to changes impacting both themselves and their staff members. Some of these questions were the same as those which were asked to individual staff members, but referred to all of the staff members who had attended the training at a particular centre. Some of these questions required "yes" or "no" answers, while others included options for "yes, to a large degree or extent/ yes, all of the time", "yes, to a small degree or extent/ yes, some of the time" and "no". The positive responses for those questions with more than one "yes" option were therefore combined, for comparison with the "yes" and "no" questions. Figure 12 shows the percentage of managers that indicated that these improvements have occurred to some extent for both themselves and their staff members as a result of the training which they have attended. Table 10 provides the key for Figure 12, as the intervention areas have been numbered for the graph.

**Figure 12: Percentage of managers that indicated the changes which have taken place as a result of the training**

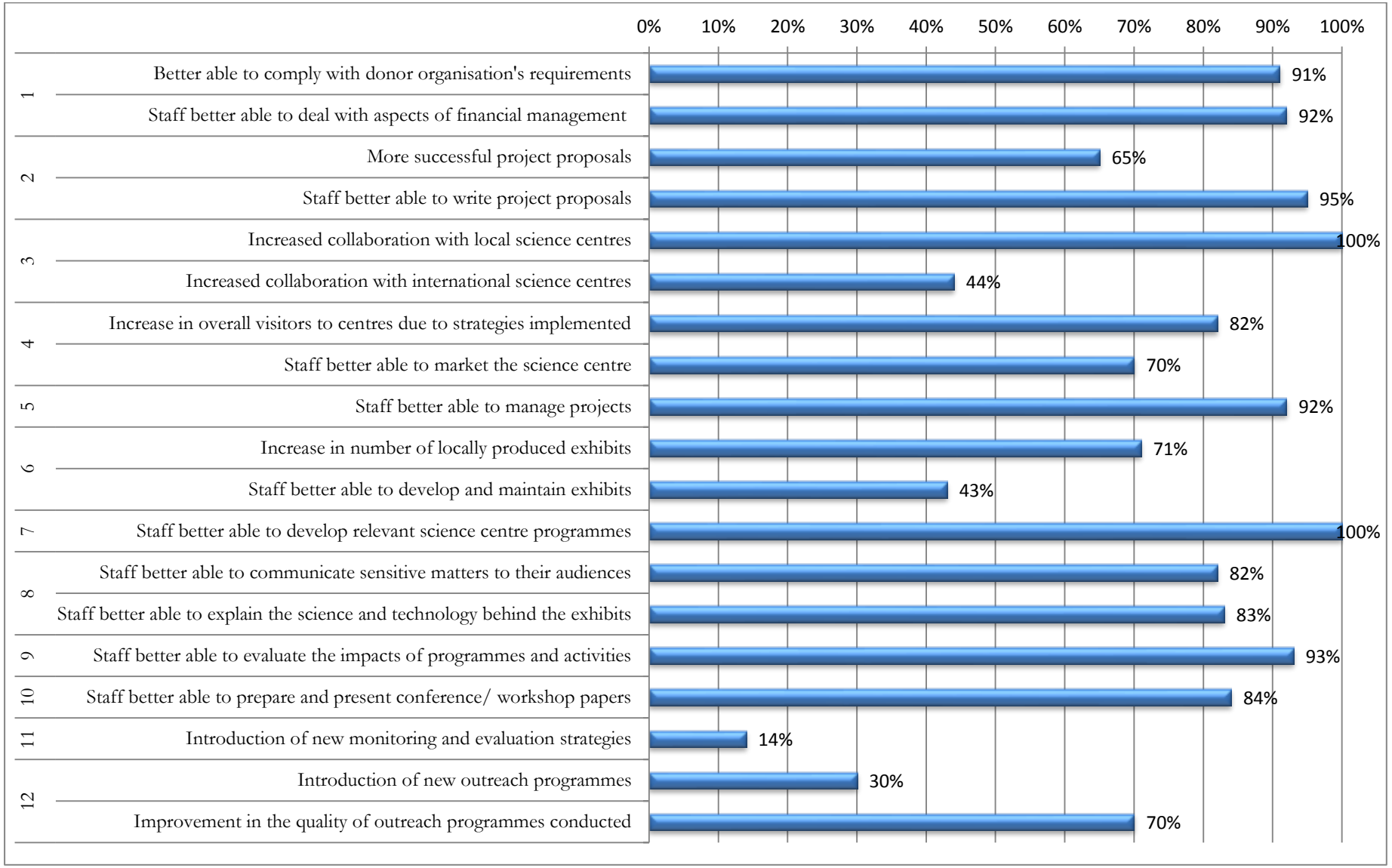


**Table 10: Key for Figure 12**

| Key for Figure 10[5] | | | |
|---|---|---|---|
| **1** | Financial management | **7** | Developing relevant science centre programmes |
| **2** | Project proposal writing | **8** | Communicating science exhibits to diverse audiences |
| **3** | Networking skills | **9** | Impact evaluation |
| **4** | Marketing | **10** | Preparing and presenting conference/workshop papers |
| **5** | Project management | **11** | Running a science centre |
| **6** | Exhibit development | **12** | Science centre outreach programmes |

The SCCB training has clearly had some important positive impacts with regards to many of the intervention areas[6]. This is evident as out of the 19 changes, only four of them were reported as having occurred in less than 60% of the respondent centres, and 14 showed an improvement in 70% or more of the centres to varying degrees.

Improvements can be noted in financial management, project management and impact evaluation, with an impact of the training being reported by managers in around 90% of the respondent science centres. Project proposal writing has also been impacted, with 95% of managers indicating that their staff members are better able to write project proposals. Aspects of marketing were noted to have improved in between 70% and 82% of the science centres, and all of the respondent managers stated that staff members are better to able to develop relevant science centre programmes as a result of the training. Around 80% of the managers also highlighted improvements in communicating science exhibits to diverse audiences and preparing and presenting conference/workshop papers. The degree of change varied across intervention areas, as managers were asked to indicate whether these changes occurred to a small extent or degree/some of the time, or to a large extent or degree/all of the time. Despite this, the fact that a high percentage of centres have seen some improvement provides a basis for further learning and changes within these centres.

Other areas of the training have had a more limited impact, such as an improvement in the ability of staff members to develop and maintain exhibits (43%). The training has also only resulted in just over a quarter of the respondent centres introducing new outreach programmes and only 14% introducing new monitoring and evaluation strategies. However, in addition, one manager noted that they were working with another institution to develop new strategies, and another highlighted that they had modified their strategies as a result of the training, through making changes to the frequency with which evaluation forms are issued and the method of analysing/interpreting these forms, as well as simplifying their questionnaires. In terms of the outreach programmes, although few of the centres have introduced new programmes, 70% of managers noted that there has been an increase in the quality of their outreach programmes. Therefore, centres may be focusing on using what they learned from the training to improve the quality of their existing outreach programmes rather than implementing a range of new ones. Exhibit development, monitoring and evaluation, and conducting outreach programmes form

[5] There were no responses in the section for "establishing a science centre"

[6] The percentages for phase 2 (questionnaires) were calculated based on the number of respondents who answered each question, as some questions were not answered by all.

some of the core functions of science centres, and it is therefore concerning that the improvements in these areas as a result of the training have been limited.

Although all of the managers noted that there has been increased collaboration with local science centres[7], less than half of them indicated a degree of collaboration with international science centres, and only 6% stated that their centres enjoy a high degree of collaboration[8]. The collaborations with both local and international science centres provide an important capacity building opportunity for South African science centres. Enhanced collaboration with other centres in the country, and further opportunities for international collaboration are therefore important.

The changes which were reported as a result of the training highlight that further emphasis on certain intervention areas is required. Consequently, exhibit development, running a science centre, outreach programmes and networking, in terms of collaboration with international science centres, should be core areas which training addresses.

## 5.6. Most valuable aspects of the training for staff members

In the staff member questionnaires, respondents were asked which aspects of each of the intervention areas covered by the training they found the most valuable. This gives an indication of the areas which provide the most benefit to the staff members in terms of positively impacting their capacity. The aspects which they identified are presented in Table 11.

[7] Local collaboration has focused on designing workshops, exhibits, programmes, and science activities; sharing information and ideas; joint programmes and projects; skills development through the exchange of professional expertise, job shadowing and exchange programmes; discussions about Programmatic Support Grant Initiative proposals, and management and centre programme issues; and conducting induction programmes and science show presentations for volunteers.

[8] International collaboration has involved training opportunities; sharing of information on projects, programmes and exhibits; funding; joint programmes; sharing of resources; exchange programmes and hosting of staff from international centres; collaboration on the designing and donation of exhibits; and collaboration on advisory matters and observing best practice of science centres internationally.

**Table 11: The most valuable aspects of each of the training intervention areas**

| Intervention area | Most valuable aspects |
|---|---|
| **Financial management** | Budgeting; financial reporting; fundraising; proposal writing |
| **Project proposal writing** | Report writing; appropriate layout (formatting) and language to be used; drafting new proposals; clarity of communication |
| **Networking skills** | Learning from the experience of another centre about the value of a good network of support; and a career centre presentation |
| **Marketing** | Use of branding; the use of e-newsletters to market science centres; setting up a social media plan. |
| **Project management** | Logistics training; fundraising; putting together a budget; identifying sources of income for projects |
| **Establishing a science centre** | Evaluation of the work done in science centres; the design process and content development in exhibit building. Visiting various centres of differing sizes and cultural backgrounds, and hearing personal experiences from professionals provided insight into how centres are set up, and how they can be made relevant to learners |
| **Exhibit development** | Process from conception of the theme, to content developers, to designers, and building and maintenance of the exhibits; the importance of signs; experiments; ideas for activities for educational programming; and making displays using recycled materials |
| **Developing relevant science centre programmes** | Signs and exhibit labelling; activities for educational programming; and making displays using recycled materials |
| **Communicating science exhibits to diverse audiences** | Interacting with audiences; communicating with learners from various backgrounds; signage analysis and development; using easy to find materials to explain science; appropriate amount of signage content |
| **Impact evaluation** | Gauging the impact of the science centre; gaining insight into the science centre experience from a visitor's perspective, specifically in terms of the exhibits and signage; different evaluation tools and methods; understanding the audience; developing a link between visitor reaction and impact; the use of visitor observation and interviews as a feedback method; and how to design evaluation questionnaires |
| **Preparing and presenting conference/workshop papers** | Researching the theme; identification of a research question; writing a paper and the abstract; presentation skills; publishing papers in journals |
| **Running a science centre** | Funding; daily activities; use of different managerial strategies; dealing with employees; collaboration and designing of joint programmes with other institutions; diversifying offerings; and the use of simple household materials in activities. |
| **Science centre outreach programmes** | Considering the context within which an outreach project is designed and setup; decision making concerning the type and outcome of the programme (science awareness campaign, curriculum support programme etc); resourcing the programme: exhibits, staff and transport; and the planning of science festivals |

In order to provide further implications of the training, Figure 13 presents a number of comments from the science centre staff members about the SCCB training which took place between 2009 and 2013.

**Figure 13: Comments reflecting the importance of the SCCB training**


## 5.7. Is there a demand for further capacity building?

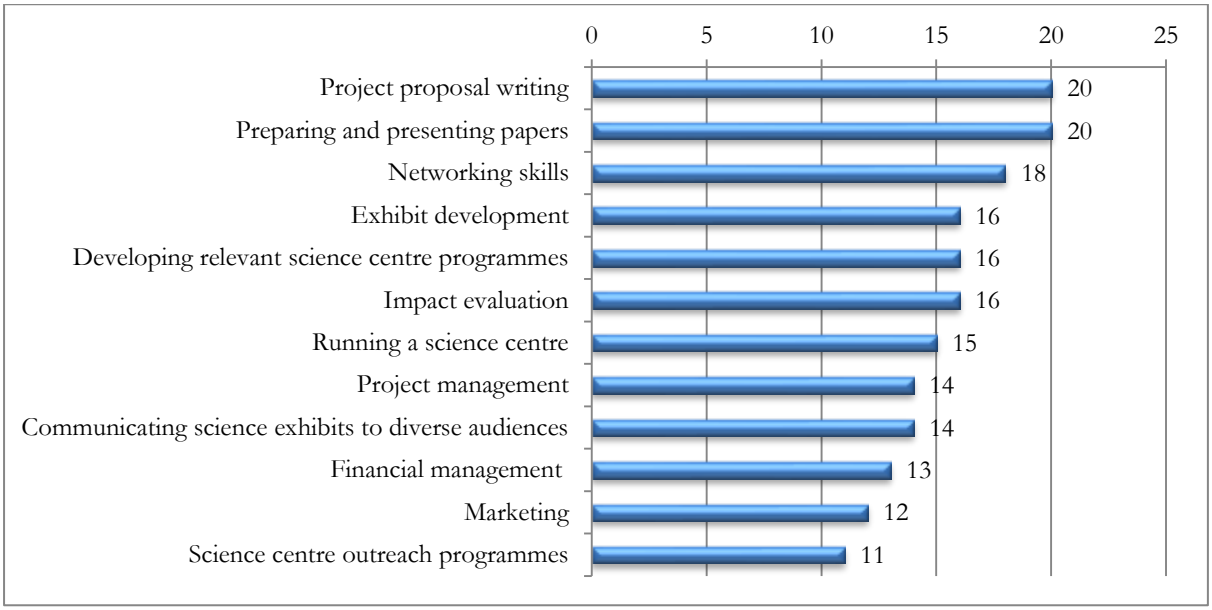
The comments provided in Figure 13 give an indication of the relevance and importance of the training for the science centre community. One science centres manager also highlighted that their development has been positively influenced by attending the training, and another re-iterated that the "training extends further than just the people who physically attend", as they are then able to pass their experiences and knowledge onto other staff members and interns at their centres. This has important implications for increasing the impact of the training.

The importance of this training was further emphasised as many science centres indicated a need for participation in further training. As explained previously, science centre managers were asked to complete the questionnaire based on the intervention areas which had been covered in the workshops or job shadowing which was attended by them or their staff members. They were then asked if they would like their staff to attend further training in these areas. Some managers also indicated that they would like their staff to attend training for areas in which they had not attended training previously. This indicates a strong desire by science centre managers for their staff to have the opportunity to be involved in the capacity building workshops and job shadowing. The managers who were unable to complete the questionnaire, due to no prior involvement in the training, were also asked to indicate which areas they would like their staff to

attend training for. One manager complied, and their responses have been included in the total numbers.

For the thirteen intervention areas, the number of managers who indicated that they would like their staff members to attend training ranged from 11 to 20, and these are shown in Figure 14. It is also highly likely that those managers who only indicated the need for further training in the areas that had been addressed in the training attended would like training in other areas as well. There were no responses to the section on "establishing a science centre".

**Figure 14: Number of managers who indicated the need for further training**




The most requested intervention areas were project proposal writing, preparing and presenting conference/workshop papers, and networking skills. Those areas which the least number of managers indicated the need for further training in were financial management, marketing and science centre outreach programmes. Financial management and marketing are specialised areas which are probably handled by one or two individuals at each centre, and science centre outreach programmes are probably limited to a few at a time.

The networking section in the questionnaire also contained a question regarding whether managers would like their staff members to be involved in job shadowing and international study visits. Ninety three percent of the managers who completed this section indicated that they would like their staff to have these opportunities. As these provide good opportunities for capacity building and learning, it can be assumed that many of the other managers would also want their staff members to take part in these forms of training.

It is important to note that the two most requested intervention areas (project proposal writing, and preparing and presenting papers) are two which showed improvements in over 80% of the science centres in Figure 12. This may indicate that managers have realised the importance of training in these areas, and have noted the improvements which have occurred so far as a result of the training. Networking skills and exhibit development, which showed some of the least

improvement, have also been requested by managers. These are crucial areas for science centres, and managers therefore seem to acknowledge the need for continued training in these areas in order for further improvements to occur. Although very few centres noted that they had introduced new outreach programmes as a result of the training, this is the least requested area. This may suggest that managers are satisfied with the outreach programmes that they already have, or feel confident in their staff's ability to introduce new outreach programmes when necessary.

### 5.7.1. Comments on the need for training in various intervention areas

This section provides input from the questionnaires, from both science centre managers and staff members, relating to the need for training in some of the intervention areas.

Science centre managers highlighted the value of training in *networking skills*, as they emphasised the importance of networking for the sharing of information, and the value of meetings arranged by DST/SAASTA with other science centres, as well as their existing collaborations with local and international science centres. One science centre highlighted the positive impact of attending international training and conferences, as well as local training, on "networking and creating a supportive and nurturing environment for the SA science centre community". They further noted that it is important for all science centres, including those that are "upcoming", to be provided with these opportunities.

Some managers suggested the importance of providing a platform, in addition to the SAASTEC conference, where science centres can share the programmes and resources they have developed with each other. One manager suggested the use of an electronic platform where plans, charts and documents can be shared.

*Exhibit development* was highlighted as critical due to the limited capacity for this in South Africa, with very few people having "the ability, skills and knowledge of science, technology and education to contribute". It was also noted that the importing of exhibits is prohibitively expensive, and more local capacity is thus required. A lack of the necessary budget for exhibit development was also emphasised by one science centre; and the manager of Sci-Bono stated that they would be willing to provide exhibit development training to other science centres, as they possess a well-developed exhibition team. It was suggested that if science centres can keep producing good quality local exhibits it will continue to draw people to science and technology, further highlighting a need for capacity in this area.

Some managers noted that in terms of *communicating science exhibits to diverse audiences*, they are attempting to incorporate other South African languages including Zulu and Setswana, however some difficulties are encountered such as the lack of scientific and technical terms in Setswana. It may therefore be necessary to address the inclusion of various languages within the capacity building training. A further comment regarding communicating science exhibits focused on the strong need for this training as it is important to teach science at a young age, and many "science communicators are not trained to deal with young minds".

*Impact evaluation* was highlighted as another vital area in which South Africa is lagging behind. A platform for sharing and publishing impact evaluation data was therefore suggested for science centres, in addition to further training opportunities. Managers also suggested that *project management* is an "essential skill for sustainability" and recommended regular training related to this area, particularly due to the turnover of staff; as well as training at various National Qualifications Framework (NQF) levels.

Intense training in *running a science centre* was also suggested, as many of the science centres have limited human resources and, in some cases, DST or other volunteers are employed at the science centres and leave when their short term contracts are finished. The need for further training in *preparing and presenting conference/workshop papers* was highlighted by one science centre as necessary as staff who had attended the training had since left the centre. This reiterates the need for regular training in all intervention areas as staff may leave, resulting in gaps in knowledge at the centres. It was also suggested that training on presenting and preparing papers be held early in the year to allow time to develop papers for submission to conferences and workshops.

A number of managers and staff members from various science centres further highlighted that the training that they have attended has been beneficial to their development. They also expressed their desire for these training workshops to continue, and to be conducted on a more regular basis; as the training helps to improve on what is being done at the science centres, as well as opening up new possibilities.

### 5.7.2. What aspects of the intervention areas should training focus on?

Staff members were asked if they would like to attend further training in each of the areas which were covered in the training they had attended, and if so, what aspects they would like the training to address. A few staff members indicated they would not require any further training, suggesting that they already feel competent and confident in these areas. Table 12 provides an indication of the aspects of each intervention area which were requested by those who would like to attend further training. Some staff members also indicated aspects they would like addressed in other areas that were not covered in the training they had attended, and these are also included. Some of the aspects are more general, while others are very specific. Table 12 provides only some examples of the aspects which staff need further training in, and it is consequently important to continuously engage with science centres to understand where they require training.

### Table 12: Aspects of the intervention areas requested by science centres

| Intervention area | Aspects requested |
|---|---|
| **Financial management** | Financial planning; financing projects; business planning; sourcing funding from sponsors and funders |
| **Project proposal writing** | Writing a proposal; project aspects: scope, time, budget, quality, management |
| **Networking skills** | Keeping long term stakeholders; opportunities to network with local government and academics; international networking |
| **Marketing** | Drawing the general public; marketing communication skills; marketing communication decisions; social media |
| **Project management** | Procurement; administration; project quality; risk management; leadership management; development facilitation; time management |
| **Establishing a science centre** | Where to start; how to write funding proposals |
| **Exhibit development** | Exhibits linked to school curriculums; signage writing; simplified experiments; designing and developing a themed mobile exhibition; translation of exhibit instructions; geology and electronics exhibits |
| **Developing relevant science centre programmes** | Developing programmes with limited resources; biological science and geo-science programmes |
| **Communicating science exhibits to diverse audiences** | Consideration of various levels of audience; programmes for physically and mentally disabled individuals; communicating exhibits to audiences of different ages; appropriate amount and type of content for exhibit signage |
| **Impact evaluation** | How to create an evaluation tool; different technologies and mediums for collecting feedback; impact studies on curriculum based activities; internationally used tools; evaluating science centre projects; evaluating the relevance of the centre to the immediate surrounding community |
| **Preparing and presenting conference/ workshop papers** | Producing a full conference paper; how to choose a relevant paper/workshop topic; writing a joint paper/ presenting a joint topic; how to develop unique presentations; publishing international papers; creating rapport and confidence |
| **Running a science centre** | Sourcing sponsorship and funding for the science centre; staff management; strategic planning; writing specifications for exhibits, to enable engaging various service providers |
| **Science centre outreach programmes** | Evaluating what an outreach programme can realistically achieve; difference between awareness campaigns and school support campaigns; expanding outreach knowledge; attracting more public to outreach programmes and the centre |

Part five of this report has explored the results of phase 2 of the study, which involved the completion of questionnaires by science centre managers and staff members. Part six presents the results from the online survey which was developed for phase 3 of the study.

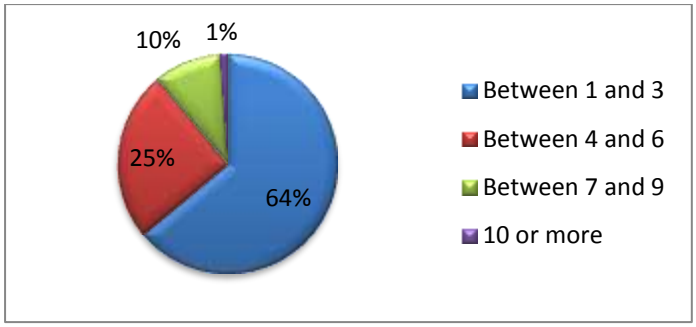
# Part Six: Findings from Phase 3

This section explores the findings from phase 3 of the data collection. The involvement of the participants in the training is presented, as well as their profiles. The existence of enabling environments for the transfer of knowledge at the science centres is then examined. The career paths of those who have left the science centres is explored, as well as any studying which participants have undertaken since attending training. Part six concludes with recommendations concerning the ways in which the communication, organisation and content of the training can be improved.

## 6.1. Involvement of participants in the training

Figure 15 indicates the percentage of participants[9] from the online survey who attended between 1 and 3 workshops, between 4 and 6 workshops, between 7 and 9 workshops, and more than 10 workshops. The majority of respondents have attended between one and three workshops, while a quarter have taken part in between four and six. One participant had attended all 14 of the workshops. Twenty three of the participants had also been involved in job shadowing between 2011 and 2014.

**Figure 15: Number of workshops attended by participants**




## 6.2. Who were the respondents for phase 3?

Table 13 shows the profiles of the respondents to the online survey. Some of the managers completed both the questionnaires (phase 2) and the online survey, and a few staff members would also have completed both.

[9] All of the percentages from the online survey were calculated out of the number of participants who responded to each question, as some questions were not answered by all. The lowest number of responses for a question was 66 out of the total 73.

### Table 13: Profiles of the online survey respondents

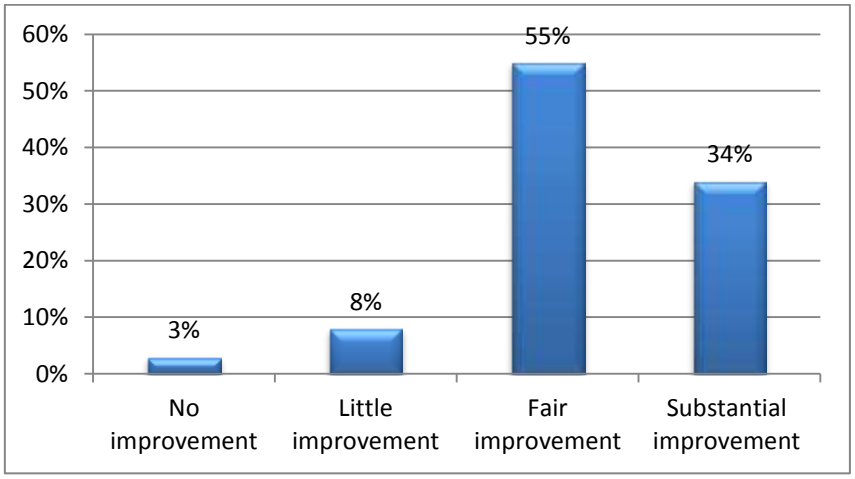
| **Race** | **Percentage of respondents** |
|---|---|
| Black | 76% |
| Coloured | 6% |
| Indian | 4% |
| White | 12% |
| Other | 1% |
| **Sex** | |
| Male | 49% |
| Female | 51% |
| **Age** | |
| Under 25 | 7% |
| 25-35 | 46% |
| 35-45 | 16% |
| 45-55 | 24% |
| 55-65 | 6% |
| 65 and over | 1% |
| **Position at the time of training** | |
| Manager/ Deputy manager/CEO/Director/Acting director | 29% |
| Volunteer/intern | 21% |
| Science communicator | 14% |
| Education officer | 13% |
| Co-ordinator or facilitator (projects, programmes, mobile science lab, ICT) | 7% |
| Assistant educator | 3% |
| Career counsellor/ language and career guidance educator | 3% |
| Education manager | 3% |
| Operations officer | 1% |
| Curriculum developer | 1% |
| Mentor | 1% |
| Mathematician | 1% |
| Technical | 1% |
| Administrator | 1% |
| **Time in that position (months)** | |
| < 12 months | 31% |
| 12-36 months | 31% |
| 37-60 months | 18% |
| 61-96 months | 13% |
| 97-120 months | 2% |
| 121-180 months | 4% |
| **Highest educational qualification** | |
| Diploma/national diploma/certificate/ A+ | 13% |
| Degree | 32% |
| Post graduate diploma | 9% |
| Honours degree | 24% |
| Masters | 15% |
| PhD | 7% |

## 6.3. Improvement in the capacity of participants

The capacity of staff members is important in determining the effective completion of their responsibilities, as well as the service delivery capacity of science centres. Consequently it is important to understand whether the training which has taken place has resulted in an improvement in the capacity of participants.

The online survey therefore asked participants to what extent the training had improved their capacity for their jobs, based on a rating scale from "no improvement" to "substantial improvement". Eighty nine percent of the respondents indicated that the training had resulted in a fair to substantial improvement in their capacity for their jobs, while only 3% stated that the training had no impact on their capacity. This indicates that the training has had an important positive impact on the capacity of participants, with about half of the participants stating that it has resulted in a fair improvement. The results are shown in Figure 16.

**Figure 16: Improvement in the capacity of staff members as a result of the training**




## 6.4. Enabling environments at the science centres

The existence of an enabling environment at science centres, which provides the opportunity for staff members to apply the knowledge gained from the training, is an important indicator of the extent to which the transfer of knowledge can occur within the science centres, and the impact on the capacity of the science centre itself. Respondents were therefore asked questions in the online survey regarding the environment of their science centre or institution, and the extent to which they were encouraged to share their knowledge or put it into practice. The results of these are shown in the following graphs.

### 6.4.1. Encouragement from managers and co-workers

Figure 17 indicates the extent to which science centre managers encouraged staff members to apply the knowledge they gained from the training, and Figure 18 shows the extent to which the participants' co-workers encouraged them to apply or share the knowledge they had gained.

**Figure 17: Encouragement from managers**

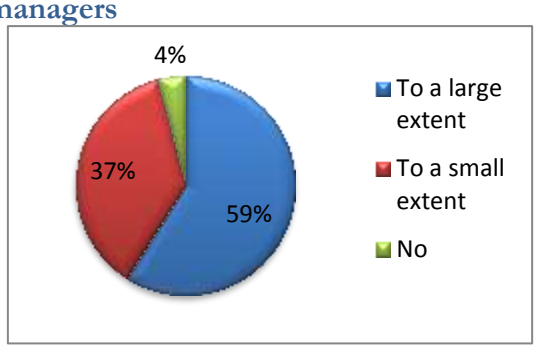
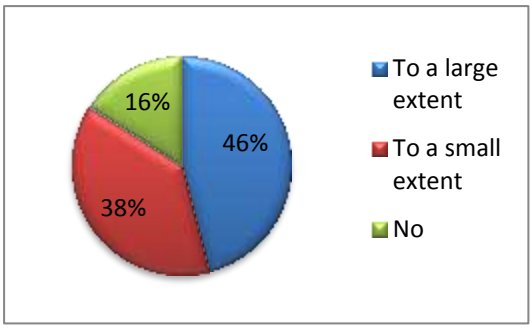



**Figure 18: Encouragement from co-workers**

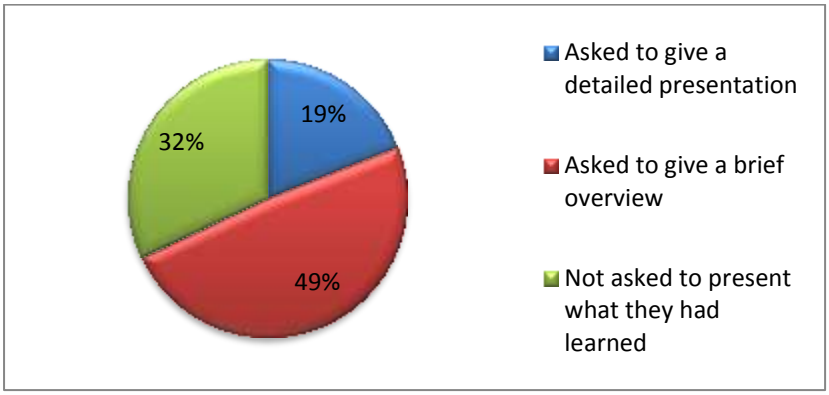



Ninety six percent of participants stated that their managers had encouraged them to apply the knowledge they had gained to their job responsibilities, and 84% highlighted that their co-workers had encouraged them to apply their knowledge or to share it with them. Less than 5% of managers were not encouraging, while a higher percent of co-workers (16%) did not encourage participants to transfer their knowledge within the science centres.

### 6.4.2. The transfer of knowledge within the science centres

The transfer of knowledge was also addressed through asking participants whether they were required to present what they had learned to the other staff members at their respective centres or institutions, whether in the form of a detailed presentation or a brief overview. Figure 19 shows that 68% of respondents were asked to share what they had learned from the training in some form, thereby ensuring that the knowledge gained is transferred to others.

**Figure 19: Percentage of staff members who were asked to present what they had learned**



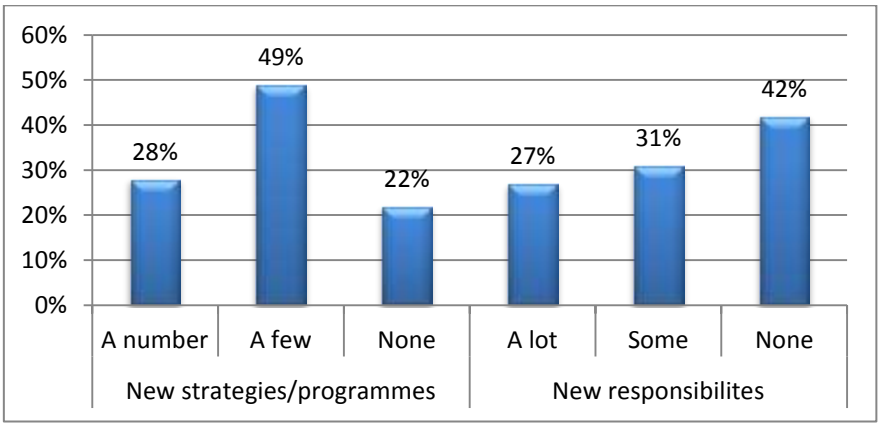

Nearly half of the participants were asked to give a brief overview of what they had learned, while 19% were requested to give a detailed presentation to their co-workers, thereby imparting a high level of knowledge to the other staff members at the centre. Almost a third of the participants however indicated that they were not asked to present what they had learned in any form. This is perhaps an area where science centres and institution can be encouraged to ensure that the knowledge gained by those who attend the training is shared with others in some form.

### 6.4.3. The practical application of the knowledge gained from training

Figure 20 indicates the percentage of respondents who were given new responsibilities or asked to implement new strategies or programmes after attending the training workshops. This is a

further indication of the extent to which the training has a practical impact on the capacity of staff members and their science centres.

**Figure 20: Percentage of staff members that were given new responsibilities or asked to implement new strategies or programmes**




Seventy seven percent of the participants were asked to implement at least some new strategies or programmes after they had attended the training. This indicates a large impact on the participants' science centres, as the knowledge which is gained through the capacity building is incorporated into the management of the science centres and institutions in many cases. Just less than 60% of the participants also highlighted that they were given new responsibilities after attending the training. Although this is a lower number, this may be because some of the training which is attended assists participants with the responsibilities that they already have, rather than providing them with knowledge which could be used to undertake new responsibilities.

Many of the science centres and institutions have therefore provided an environment which encourages the transfer of knowledge from those who have attended the training to other staff members, as well as promoting the practical implementation of this knowledge.

## 6.5. Where are they now?

An important finding of the online survey was that 91% of respondents have remained at the science centres since they attended the training. In addition, of the six participants who have since left, four of them indicated that they have been able to use the knowledge which they gained from the training in their new jobs. The other two participants only attended one workshop each, and these did not provide them with knowledge which is relevant to their current positions. Table 14 shows where the six participants who have left the science centres have moved to, by organisation and the positions they have occupied.

It is important to bear in mind that those who have left the science centres would have been less likely to respond to the survey, but this does indicate that the knowledge is retained within the centres to some extent.

**Table 14: The labour market trajectories of those participants who have left the centres**

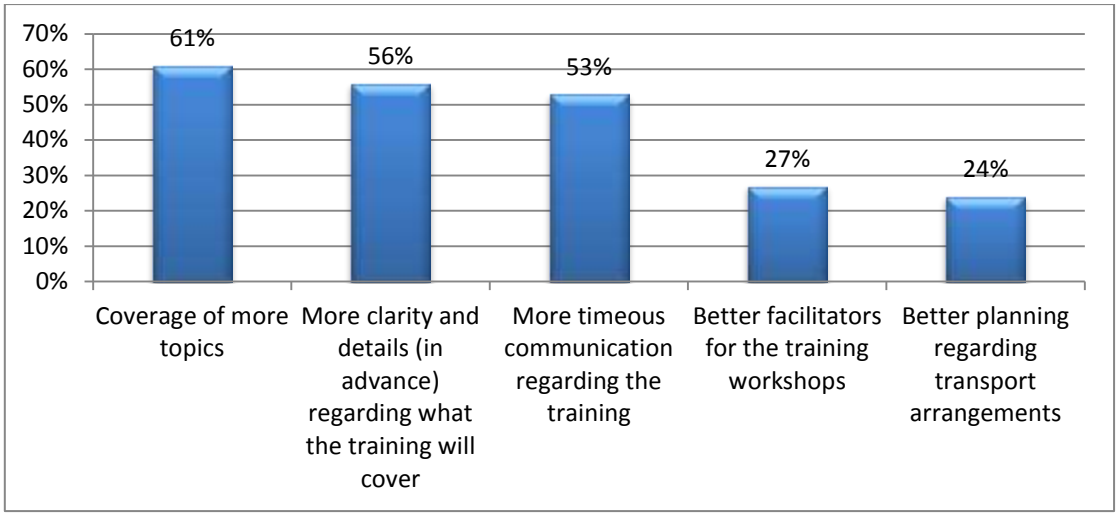
| Participant | Organisation 1 | Position 1 | Organisation 2 | Position 2 |
|---|---|---|---|---|
| **1** | British High Commission | Science and innovation officer | DST | Deputy Director of Space Science and Technology |
| **2** | CSIR/UKZN | PhD candidate POP Programme | | |
| **3** | Mehlwana Secondary | Deputy Head | | |
| **4** | Sedibeng College | Lecturer | | |
| **5** | Sithabile Technology Services | Internal Support Administrator (learnership) | | |
| **6** | The Peace Agency | Regional Project Co-ordinator | | |

Participants were also asked whether they have studied further since attending the SCCB training. Seventeen of the respondents from phase 3 indicated that they have studied further, with their pursuits encompassing a variety of subjects and qualifications. Participants indicated they had studied project management, Honours in Physics, science communication, a PhD, school management, master of business leadership (MBL), a post-graduate diploma in the theory and practice of science centres, Honours in Maths and Science, practical microbiology, business management, generic management, a Doctor of Education (D Ed), research, quality management and a Post-Graduate Certificate in Education (PGCE). The labour market trajectories of participants who leave the science centres and the studying which is undertaken post training are important factors, as the long term impact of the training can be determined by whether participants can use the training in future jobs, and whether their studies are related to the experience they have gained through the training.

## 6.6. Areas for improvement: communication, organisation and content

In order to ensure that the SCCB training is successful in building the capacity of science centres in South Africa, it is important to identify areas where improvements can be made. Therefore, in both the questionnaires and the online survey, respondents were asked to identify ways in which the training can be improved, in terms of communication, logistics or organisation, and content. The online survey requested respondents to indicate ways in which the training can be improved from those shown in Figure 21.

**Figure 21: Improvements which can be made to the training**




Sixty one percent of the respondents indicated the need for covering more topics in the training workshops. Over half of them also highlighted the need for more clarity regarding what the training will cover and more timeous communication. Both of these aspects will allow them to better plan for attending the training, and selecting the people who will benefit the most from the training. About a quarter of the respondents indicated the need for better facilitators and better logistics arrangements for the training workshops.

Respondents were then asked to give any further suggestions, and these have been combined with the suggestions from the manager and staff member questionnaires from phase 2 of the study. It was suggested that new material is continuously introduced rather than recycling old material, and that training is expanded to allow for more science centre staff members to attend the training, as opposed to a few people attending all of the workshops. This could also be achieved by having these workshops more frequently, in order to allow more people to participate. It was also noted that more practical examples would be useful in the training, particularly in terms of dramatization, as this is a good way to impart the information to the audience.

Some respondents also advised that it would be useful to have training which is directed at the different roles at the science centres, rather than having 'blanket training' for everyone. For example, one respondent suggested that managers, directors and CEO's should receive more strategic, leadership and innovation training. Related to this, it was suggested that science centres should be consulted with in order to identify which topics would be the most beneficial to them for training.

It was also recommended that more information regarding the training is provided to the science centres before they are asked to submit names for the workshops, including who the facilitators will be, as this will allow them to identify the most suitable staff for these empowerment opportunities. One respondent proposed that SAASTA could recommend the appropriate level of staff that should attend each training session.

A number of suggestions were made in relation to the facilitators of the training. It was recommended that where appropriate, training should be conducted by people within the science centre community, thereby drawing on their expertise in the field. This included a suggestion that training should harness the talent from managers as a vital source of experience on the science centre environment. In those cases where the facilitators come from outside the science centre community, it was advised that they familiarise themselves with the work that is done at science centres, in order to have an understanding of the role of science centres. This will better allow them to share relevant information, best practices and expertise. One respondent also highlighted the need for professional facilitators, and suggested inviting international facilitators.

Some respondents advocated longer workshops, as they receive a large volume of information in a short period of time. They therefore feel that more time is necessary for them to grasp the concepts which they are presented with, and to learn how to apply them efficiently. It was also proposed that certificates are issued to the participants of the training, and that training is linked to formal qualifications and accreditation.

Participants also highlighted that communication concerning the workshops is often not timeous, sometimes does not reach the managers directly, and is at times incomplete. Science centres therefore find out about the workshops with very little time for planning, and as many of them operate with a limited budget and a small staff, they need to be informed in advance. Consequently, they are not able to take advantage of the opportunities for training due to other commitments.

A further suggestion involved the need for undertaking evaluation of the workshops immediately after they are completed, or within a short period of time thereafter. This will allow participants to remember more and be able to provide more accurate evaluations. This could be in the form of a report or short review which is submitted by those who attended the workshops. Although some of the workshops were evaluated in this manner, there is a need to ensure that they all are.

## 6.7. Overall impact of the SCCB training

The preceding sections have highlighted the impact which the various workshops and the job shadowing programme have had, in terms of improvements in the capacity of staff in general, and in relation to specific aspects of the intervention areas. It has also been shown that many of the science centres and institutions have provided an environment which encourages the transfer of knowledge from those have attended the training to other staff members, as well as translating this knowledge into practice. This will consequently translate into more efficient management of the centres, their improved functioning and enhanced effectiveness in playing a role in the promotion of science and technology in South Africa. The final part of this report presents a number of recommendations from this study.

## Part Seven: Recommendations

The SCCB training has had a positive impact on many of the science centres and institutions that have had the opportunity to participate in the various workshops and the job shadowing programme. It is now important to identify ways in which the impact of the training can be increased in order to ensure long term effects of the capacity building. A number of recommendations can be made in this regard, based on the findings of the study. These are presented in Table 15.

### Table 15: Findings and recommendations from the SCCB training evaluation

| Findings | Recommendations |
|---|---|
| **A range of workshops covering diverse topics were offered through the SCCB project between 2009 and 2014. These workshops have provided participants with valuable experience in a range of areas.** | A set of core modules should be identified which cover the most important areas related to the activities carried out in science centres and outreach programmes of the institutions. These core modules should be presented annually in order to ensure that all science centre staff members acquire the essential knowledge and skills. |
| **Science centres employ people in a variety of different positions, and each of these positions is associated with specific responsibilities. Training is not necessarily targeted at specific positions.** | It may be useful to have training which is directed at the different roles in the science centres. Specific workshops could therefore be developed which focus on the roles and responsibilities of science communicators, education officers, project co-ordinators and so on. This would ensure that those who attend the training will benefit from training which focuses specifically on the duties which they perform. |
| **These workshops do provide participants with valuable knowledge and expertise which will assist them in their jobs.** | Consequently, it is important that the workshop facilitators are well trained and able to impart their knowledge in an effective manner. Managers of science centres and experienced science centre staff are a critical source of experience on the science centre environment, and their expertise should be harnessed for these workshops.<br><br>In those cases where the facilitators come from outside the science centre community, it is important that they familiarise themselves with the work that is done at science centres. This will enable them to share relevant information and best practices which science centres can incorporate. |
| **Some of the science centres have limited capacity or limited experience, particularly those with only a few staff members or those who rely on volunteers, as well as those that are newly established.** | They therefore need to receive training which is timeous and relevant to their activities. In order to ensure that science centres are receiving training which is timeous and relevant to their needs, it is necessary to continue to engage with them on a regular basis to ascertain what intervention areas and aspects they require training to focus on. Many science centres are growing and learning, and such training is therefore critical to their continued improvement and expansion.<br><br>It is also important to ensure that possible participants are advised of the training in advance, and provided with sufficient details regarding what the training will cover. This will allow science centres to plan their schedules so that they are able to send staff members to the training, and will ensure that those who are sent to the training are those who will benefit the most from it. |

| | |
|---|---|
| | It may also be possible to harness the experience and expertise of the larger centres in assisting the smaller and newer ones. The more experienced centres may be able to provide specific training for those areas in which they have extensive knowledge and capacity. They may also be able to advise the other centres with regard to their daily activities, strategies and programmes. This could occur through a mentorship programme, or through workshops which provide these centres with the opportunity to engage with those with more experience, and to share ideas and planning strategies.<br><br>Furthermore, interns or additional staff could be provided for those centres which have one or limited staff members. This would assist them in expanding their activities and increasing their impact. |
| **When exploring the changes that have occurred in science centres as a result of the training, in terms of various aspects of the intervention areas, it was found that four intervention areas have shown limited improvement. Exhibit development, networking, running a science centre, and science centre outreach programmes form some of the core functions of science centres, and it is therefore concerning that the impact of the training on these areas has been limited.** | Consequently, it is crucial that these intervention areas are further focused on through the SCCB training. Improvement was shown in the quality of outreach programmes (70%), and increased collaboration with local science centres was highlighted by all respondent centres. Therefore, a focus on exhibit development, networking with international science centres, and introducing new monitoring and evaluation strategies (running a science centre) and new outreach programmes are important aspects to focus on.<br><br>In addition, there is a need for continued focus on building the science centre network in the country. |
| **A high percentage of staff that completed the online survey have remained at their respective science centre. However in some cases, particularly where there are a large number of volunteers on short term contracts working at a science centre, there is a high turnover of staff.** | It is therefore vital to find ways of retaining this knowledge and experience at the science centres. The transfer of knowledge needs to occur from those who have attended the training to the other staff members at the science centres. This may be achieved through internal seminars or presentations at the science centres, which provide an opportunity for the sharing of knowledge and experiences. These could be encouraged or facilitated by SAASTA.<br><br>As some of these centres are very small and therefore have limited capacity, it would be beneficial for them to be able to employ more permanent staff members in order to provide a core of people who will remain there, and possess the relevant skills. This will ensure the retention of human capacity. |
| **It was noted that many of the participants have a high level of education, with many of them having degrees and higher qualifications. Many of the staff members at the science centres are therefore qualified individuals who possess knowledge and expertise in their fields.** | It is consequently important to ensure career pathing within the science centres to encourage staff members to remain in the science centre network and thereby promote the retention of staff members. This will also increase the capacity of science centres, as staff members will gain important experience and skills over the long term.<br><br>Providing participants of the training with certificates, and linking training to formal qualifications and accreditation, may also encourage staff to remain at the science centres in order to access such valuable qualifications. |

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| **Training has had an important positive impact in improving the capacity of staff members. Extending the reach of the training would allow more staff members at more science centres and institutions to participate, thereby enhancing capacity in the science centre network.** | This may be achieved through conducting the same workshops on more than one occasion in order to include a greater number of science centres, or by developing workshops which can accommodate more people at one time. This will also contribute to promoting networking between local science centres.<br><br>Online databases of the training material which has been presented at the workshops would also ensure that more staff members at more centres are able to benefit from the training. In addition, new staff members who join the centres will have the opportunity to gain the related knowledge and experience. This will also assist in minimising the loss of knowledge from the centres when those who have attended the training leave.<br><br>A further intervention which would assist science centres would be for SAASTA to publish a science centre handbook or series of booklets, which address the various intervention areas which are covered in the training. These could be provided in hard copy or electronically, and would provide the science centres with a guide to their day to day management, whether or not they have been able to attend the workshops. |

The SCCB training has had an important impact on the capacity of science centres and their staff members, and there is a continued demand for training of this nature. This is particularly important within South Africa where science and technology are set to play a crucial role in the country's future development. SAASTA's role in the capacity building of these science centres is therefore central to the development of the South African science centre network.

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# Appendices

## Appendix A: Presentations at the annual SAASTEC Conferences

(Posters are included where they were noted in the reports)

| 12th SAASTEC Conference 2009<br>South African Astronomical Observatory, Cape Town | |
|---|---|
| **Science Centre** | **Presenters** |
| Cape Town Science Centre | John Crossland, Jani de Bruin, Michael Ellis, Julie Cleverdon |
| HartRAO | Anacletta Koloko, Marion West, Sam Rametse (presented by Anacletta Koloko) |
| KZN Science Centre | Candice Rajah, Allison Ruiters |
| NECSA Visitor Centre | Gilbert Lekwe |
| Nelson Mandela Bay Science and Technology Centre | Peter McEwan |
| North-West University Science Centre Potchefstroom | Jan Smit |
| South African Astronomical Observatory | Kevin Govender, Sivuyile Manxoyi |
| SANSA | Elisa Fraser, Candice Arendse, Msizi Khathide, Mdumiseni Nxumalo |
| Sci-Bono Discovery Centre | David Kramer, Fannie Matumba, Michael Peter, Stuart Hopwood, Thandi O'Hagan (poster) |
| Sci-Enza | Nadine Broodryk, Irene van Nugteren, Puleng Tsie, Helga Nordhoff, Rudi Horak, Nondumiso Mntuyedwa (poster), Boitumela Pitsi (poster) |
| University of KwaZulu-Natal Science and Technology Education Centre | Tanja Reinhardt, Asokaran Rajh |
| Unizulu Science Centre | Derek Fish, Geraldine Genevive Lazarus, Diane Stacey Naidoo |

| 13th SAASTEC Conference 2010<br>ArcelorMittal Science Centre and School of Excellence, Vredenburg | |
|---|---|
| **Science Centre** | **Presenters** |
| ArcelorMittal Science Centre | Tebogo Habedi (Newcastle), Koos Claassens (Newcastle), Thami Mphokela (Sebokeng) |
| Cape Town Science Centre | Michael Ellis, Julie Cleverdon, John Crossland, Fikiswa Majola |
| KZN Science Centre | Allison Ruiters, Candice Potgieter |
| Mondi Science, Career Guidance and FET Skills Centre | Mondli Mnguni |
| National Zoological Gardens | Elize De Jager |
| NECSA Visitor Centre | Gilbert Lekwe |
| Nelson Mandela Bay Science and Technology Centre | Peter McEwan |
| Osizweni Education and Development Centre | Yavni Bar-Yam, Donald Seanego, Mthobisi Nzimande, Nobuhle Masilela, Gloria Rathogwa, Busi Tshabalala, Bella Manabile, Vuyiswa Ndengane, Alfred Tsipa, Joeph Sibiya, Daniel Maubane |
| South African Astronomical Observatory | Kevin Govender |
| SANSA | Elisa Fraser |
| Sci-Bono Discovery Centre | Dorothy Koka, David Kramer, Michael Peter, Fannie Matumba, Stuart Hopwood |
| Sci-Enza | Thina Msomi,, Helga Nordhoff, Irene Schoeman, Paballo Bapela, Dineo Makala, Puleng Tsie, Rudi Horak, Kagiso Matshika, Vusani Victoria Mathada, Boitumelo Elijah Pitsi,<br>Thabiso Mogoatlhe, Godfrey Kgatle |
| University of KwaZulu-Natal Science and Technology Education Centre | Tanja Reinhardt |
| Unizulu Science Centre | Derek Fish, Marty Schwartz, Mdumiseni Nxumalo |

| 14th SAASTEC Conference 2012<br>National Zoological Gardens, Pretoria | |
|---|---|
| **Science Centre** | **Presenters** |
| Anglo-American Science, Career Guidance and ICT resource centre | Jan Seopa |
| ArcelorMittal Science Centre | Tebogo Habedi (Newcastle), Alinah Masobela (Sebokeng), Daniel Motsapi, Khuliso Makungo |
| Boyden Observatory Science Centre | MJH Hoffman, JH Greyling, PM Lamusse, C Erasmus, HJ van Heerden |
| Cape Town Science Centre | Jani DeBruin, Julie Cleverdon, John Crossland |
| FOSST Discovery Centre | Pumezo Kwinana |
| Giyani Science Centre | Norman Mthembi |
| HartRAO | Thandi O'Hagan, Fikiswa Majola |
| KZN Science Centre | Candice Potgieter |
| National Zoological Gardens | Elize de Jager, Armstrong Mashakeni, Ulrich Oberprieler, Paul Bartels, Desiré Dalton |
| Nelson Mandela Bay Science and Technology Centre | Robyn Rütters |
| Osizweni Education and Development Centre | Hideo Nakano, Alfred Tsipa |
| SANSA | Msizi Khathide |
| Sci-Bono Discovery Centre | Trust Nkomo, Fannie Matumba, Thabang Molise, Trevor McGurk, Stuart Hopwood, Michael Ellis, Michael Peter, David Kramer, Akash Dusrath, Thami Mangena |
| Sci-Enza | Irene Schoeman, Koena Selatile, Rudi Horak, Given Ratsoma, Affinity Muzhinduki, Stuart Hopwood |
| University of KwaZulu-Natal Science and Technology Education Centre | Tanja Reinhardt, Kumesh Naidoo |
| Unizulu Science Centre | Derek Fish, MJ Schwartz, Diane Stacey Naidoo, Mdumiseni Nxumalo |

| 15th SAASTEC Conference 2013<br>Durban Natural Science Museum, Durban | |
|---|---|
| **Science Centre** | **Presenters** |
| Anglo-American Science, Career Guidance and ICT resource centre | Jan Seopa |
| ArcelorMittal Science Centre | Puleng Tsie (Newcastle), Tebogo Habedi (Newcastle), Busisiwe Maqubela (Saldanha), Thami Mphokela (Sebokeng), Daniel Motsapi |
| Cape Town Science Centre | Julie Cleverdon |
| Johannesburg City Parks | Kogie Moodley |
| KZN Science Centre | Nazley Kast, Kesigan Govender, Celiwe Chauca, Candice Potgieter, Chantal Motilall |
| Mondi Science, Career Guidance and FET Skills Centre | Mondli Mnguni |
| National Zoological Gardens | Elize de Jager |
| NECSA Visitor Centre | Gilbert Lekwe |
| Osizweni Education and Development Centre | Alfred Tsipa, Daniel Maubane |
| Penreach Science and Education Centre | David Gear |
| South African Astronomical Observatory | Sivuyile Manxoyi, Buzani Khumalo |
| SANSA | Elisa Fraser, Msizi Khathide |
| Sci-Bono Discovery Centre | Michael Peter, Michael Ellis, David Kramer, Francois Gerber, Stuart Hopwood, William Brits, Akash Dusrath, Thami Mangena |
| Sci-Enza | Ashlan Mohlaphuli, Irene Schoeman, Emmanuel Nekhudzhiga, Thobekani Evans Malatula, Helga Nordhoff, Rudi Horak, Colette de Villiers, Kagiso Ledwaba |
| University of KwaZulu-Natal Science and Technology Education Centre | Tanja Reinhardt |
| Unizulu Science Centre | Derek Fish, MJ Schwartz, Diane Stacey Naidoo, Mdumiseni Nxumalo, Slindile Mthembu, Simphiwe Ntshangase, Tracey Pillay, Vashania Moodley |

| 16th SAASTEC Conference 2014<br>Nelson Mandela Bay Science and Technology Centre, Uitenhage | |
|---|---|
| **Science Centre** | **Presenters** |
| ArcelorMittal Science Centres | Puleng Tsie (Newcastle), Mthobisi Mhoni (Newcastle), Busisiwe Maqubela (Saldanha), Lekgabe Dihlabi (Saldanha), Siphosethu Dudumashe (Saldanha), Phinah Manamela (Saldanha), Thami Mphokela (Sebokeng), Kagisho Seitshiro (Sebokeng), Netshiongolwe Khathutshelo Emmanuel, Manqoba Ndhela and Njabulo Mpanza (poster) (Newcastle) |
| FOSST | Zimasa Dubeni, Vuyokazi Nongogo, Thandiswa Magqebela, Sinazo Mselana, Lizo Masikisiki, Mncedi Rani, Abongile Pekana, Iviwe Dofi, Viwe Kwinana, Luleka Menzi, Zukile Ndyalivana, Hombakazi Nqandeka (poster), Nolufundo Sintwa (poster) Sisanda Makubalo (poster) |
| HartRAO | Tony Dhlamini |
| Isibusiso Esihle Science Discovery Centre | Siphesihle Bukhosini |
| iThemba Labs | Ambrose Yaga |
| Johannesburg City Parks | Kogie Moodley, Sinah Magolo |
| Mondi Science, Career Guidance and FET Skills Centre | Joseph Sibiya |
| National Zoological Gardens | Armstrong Mashakeni, Ulrich Oberprieler (poster) |
| NECSA Visitor Centre | Gilbert Lekwe |
| Nelson Mandela Bay Science and Technology Centre | Chris McCartney, Justin Downey, Singathwa Poswa, Bulelani Tokwana (presentation and poster) |
| North West University Mafikeng Science Centre | L.Y. Molebatsi and B.G Marope (poster) |
| Osizweni Education and Development Centre | Abel Garwe |
| South African Astronomical Observatory | Buzani Khumalo |
| SANSA Science Centre | Thandile Vuntu (poster) |
| Sci-Bono Discovery Centre | Michael Peter, Michael Ellis, David Kramer, Stuart Hopwood, Akash Dusrath, Thami Mangena, Trevor McGurk |
| Sci-Enza | Helga Nordhoff, Rudi Horak, Rosslyn Kekana, Ntandoyenkosi Masango, Malekantshe Johannes Segooa, Smeetha Singh, Modungwa Reletile Tshepiso, Mbali Mahlayeye |
| University of KwaZulu-Natal Science and Technology Education Centre | Tanja Reinhardt |
| University of Limpopo Science Centre | Annlize Potgieter, Martin Potgieter, JS Brits |
| Unizulu Science Centre | Derek Fish, Alfred Tsipa, MJ Schwartz, Slindile Mthembu |

## Appendix B: Presentations at the 6th Science Centre World Congress

| 6th Science Centre World Congress 2011<br>Cape Town International Convention Centre, Cape Town | |
|---|---|
| **Science Centre** | **Presenters** |
| ArcelorMittal Science Centre Saldanha | Busisiwe Maqubela |
| Boyden Observatory Science Centre | Matthiam Hoffman (poster) |
| Cape Town Science Centre | Julie Cleverdon |
| HartRAO | Marion West and Sam Rametse and Fikiswa Majola (poster) |
| Johannesburg City Parks | Nicole Fergusson and Kogie Moodley (poster) |
| National Zoological Gardens | Elize De Jager (poster), Clifford Nxomani (table host) |
| NECSA Visitor Centre | Rob Adam |
| Osizweni Education and Development Centre | Rufus Wesi, Angela Ford (poster presented by Alfred Tsipa and Rufus Wesi) |
| South African Astronomical Observatory | Kevindran Govender, Sivuyile Manxoyi |
| SANSA | Elisa Fraser (poster), Msizi Khathide (poster) |
| Sci-Bono Discovery Centre | Thandi O'Hagan (presentation and poster), Mbulaheni Fannie Matumba, Michael Peter, David Kramer (presentation and poster), Michael Ellis (table host) |
| Sci-Enza | Rudi Horak, Irene Schoeman (poster) |
| University of KwaZulu-Natal Science and Technology Education Centre | Tanja Reinhardt and Mark Horan (poster) |
| University of Limpopo Science Centre | Annelize Potgieter (poster) |
| Unizulu Science Centre | Derek Fish, Mdumiseni Nxumalo, Diane Stacey Naidoo (poster), Marthinus Schwartz (poster) |