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Advisory Services

**The Perimeter Institute for  
Theoretical Physics (PI)**

**Performance Audit  
Final Report**

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# Contents

<b>Executive Summary</b> .....	<b>1</b>
<b>Audit Objectives and Scope</b> .....	<b>1</b>
<b>Summary of Findings</b> .....	<b>1</b>
<b>Background</b> .....	<b>3</b>
<b>The Perimeter Institute for Theoretical Physics</b> .....	<b>3</b>
<b>Audit Approach and Objectives</b> .....	<b>4</b>
<b>Observations and Recommendations</b> .....	<b>6</b>
<b>1) Recruiting</b> .....	<b>6</b>
<b>2) Funding and Support</b> .....	<b>12</b>
<b>3) Structure</b> .....	<b>15</b>
<b>4) Outreach</b> .....	<b>20</b>

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# Executive Summary

The Perimeter Institute for Theoretical Physics (PI or the Institute) is required to have a performance audit completed under the terms of its funding agreement with Industry Canada. This report presents a summary of the approach followed in planning and conducting the performance audit as well as our observations and recommendations for improvement.

## Audit Objectives and Scope

The audit plan was developed using a risk-based approach through which key risks facing the continued operations of PI were identified based on interviews with PI's management as well as documentation review. The risks were then linked to the core processes and practices in place within PI that are designed to mitigate these risks. This information was used to determine the specific objectives, criteria, and scope of the audit.

The overall objective of the audit is to provide an independent assessment of PI's operations to assess the economy, efficiency, and effectiveness of Industry Canada funding used. The specific audit objectives are to assess whether:

- Strategies and practices are in place to attract and retain a world-class and leading calibre of research talent required to support PI's mandate.
- Mechanisms and plans are in place to help secure sustained funding and support for PI.
- Management structure and operational practices are in place and enable the fostering of scientific innovation and research results in accordance with PI's mandate.
- Outreach processes and practices are in place to promote the value of PI and theoretical physics to target audiences.

The scope of the audit covered PI's management controls, processes, practices and other means in place related to the audit objectives identified above. The audit fieldwork was completed on October 21, 2010, with the exception of the results of stakeholder surveys that were completed on January 21, 2011 in conjunction with a performance evaluation that was conducted concurrently with this audit. Our work was limited to, and our recommendations are based on, the audit procedures conducted, and the observations and recommendations should be considered in the context of the procedures performed. We relied on information and representations of management and others for the completeness of background information and other assertions provided.

## Summary of Findings

Overall, we found that PI has designed and implemented practices and processes that promote economy and efficiency in the use of resources and that are effective in supporting the achievement of PI objectives and expected results. The audit identified a number of positive practices currently in place within PI, including: an award winning outreach program that promotes both PI and theoretical physics to defined target audiences including students, teachers, and the general public; a management and operating structure that promotes and facilitates multi-disciplinary collaboration among PI researchers; the development of programs and partnerships that have been effective in attracting world renowned physicists and talent to PI; the development and implementation of mechanisms through which research results and discussions can be quickly and readily shared with the international community in a cost-effective manner; and, the implementation of strategies to continue PI's success in leveraging funding from both private and public sectors.

Based on the results of our interviews with external stakeholders and the extent to which PI has received positive coverage in the mainstream media over the past year, PI is clearly perceived to be a unique and valuable organization in promoting interest and awareness in science, and in creating an environment that is conducive to fostering future scientific breakthroughs. The Institute and the calibre of PI talent are highly regarded by both

internal and external stakeholders, as are the Institute's culture of innovation and focus on new ideas and opportunities that depart from traditional approaches and models.

Under the leadership of the Institute Director, PI has grown significantly over the past three years, and has put in place a defined vision that calls for further growth over the next five years on a national and international scale. While the flexibility offered by PI's current structure is one of its key success factors, as the organization continues to grow and expand, it may benefit by strengthening the formality of some of its processes to allow for greater consistency and ease of transition in times of change and growth. In particular, we recommend that management consider the following: strengthening the consistency and nature of documentation supporting hiring decisions for all positions; strengthening the consistency and nature of periodic internal performance reporting; re-visiting the role and mandate of the Scientific Advisory Committee to better reflect PI's future needs and structure; and enhancing PI's global approach to identifying and managing partnerships. It is acknowledged that these recommendations for improvement primarily relate to aspects of the organization in which documentation supporting the related activities and processes currently being followed by management may not be formalized or consistent.

Our detailed findings and recommendations are categorized under each of the four audit objectives in the "Observations and Recommendations" section of this report. PI management agrees with each of the recommendations for improvement and management's responses follow each recommendation in the "Observations and Recommendations" section.

# Background

## **The Perimeter Institute for Theoretical Physics**

PI is an independent, not-for-profit organization that was publicly announced and launched in October 2000. As a resident-based research institute devoted to foundational issues in theoretical physics at the highest levels of international excellence, PI strives to create a lively and dynamic research atmosphere where many approaches to fundamental questions, both orthodox and unorthodox, are pursued simultaneously. PI works to create educational and research opportunities for graduate students and the next generation of researchers through collaborations with the academic community. It also works to create a world-class outreach program which conveys the wonder and mystery of the universe and the importance of future scientific breakthroughs to the general public in Canada and beyond. In support of its mission and culture of innovation, the structure of the Institute has been purposely designed to enable more responsiveness and flexibility than traditional academic institutions to enable management to explore and seize opportunities on a timely basis. In addition, management's philosophy and operating style reflects its innovative culture in that activities and initiatives conducted by PI are expected to reflect new ideas that "break the mold".

Researchers at PI currently pursue six fields of study: Quantum Foundations; Quantum Information; Quantum Gravity; Superstring Theory; Particle Physics; and Cosmology. As reflected in PI's Five Year Plan, two additional fields of study are being developed to further expand their research capacity: Condensed Matter and Complex Systems. In housing these different fields in one institute, PI hopes to encourage collaboration between the different disciplines to maximize scientific breakthroughs by national and international researchers.

Perimeter Institute is located in Waterloo, Ontario and is led by an Institute Director responsible for developing and implementing the overall strategic direction of the Institute. PI employs over 120 full time equivalents to conduct and support their activities and programs, which includes hosting Distinguished Research Chairs (of which 20 have been appointed to date), over 50 students and trainees, and over 1,000 international visitors per year. The Institute is governed by a volunteer Board of Directors made up of eight members drawn from the private sector and academic community. The Board of Directors and Institute Director are supported by a Scientific Advisory Committee (SAC), an oversight body composed of international scientists that help ensure objectivity and a high standard of scientific excellence.

In 2007, Industry Canada approved a five year \$50 million funding agreement to support PI's scientific research and educational outreach activities. The agreement is intended to help support: building PI as a centre of research excellence that positions Canada for global science leadership and providing unique capacity within Canada; fostering collaborative multi-disciplinary research; promoting the dissemination of research outcomes; and attracting support from other levels of government and the private sector.

# Audit Approach and Objectives

A performance audit plan was developed using a risk-based approach through which key risks facing the continued operations of PI were identified based on interviews with PI's management and Board members as well as documentation review. The risks were then linked to the core processes and practices in place within PI that are designed to mitigate these risks. This information was used to determine the specific audit objectives and related criteria to be assessed through the examination as illustrated in the table below.

Audit Objective	Audit Criteria
<p><b>Audit Objective #1:</b>  <b>To assess the efficiency and effectiveness of strategies and practices in place to attract and retain a world-class and leading calibre of research talent required to support PI's mandate.</b></p>	<p>Criteria 1.1: Mechanisms are in place to identify the world's best research talent and to promote the Institute to potential candidates and students.</p> <p>Criteria 1.2: Processes and procedures have been designed and are followed to enable an objective and comprehensive assessment of the quality of recruitment candidates and to prioritize and approve recruitment decisions.</p> <p>Criteria 1.3: Mechanisms are in place to identify and implement working and living conditions that are effective in attracting and retaining the world's best research talent.</p> <p>Criteria 1.4: There is a process in place to assess the overall satisfaction of PI recruits and students and to take corrective action as necessary.</p>
<p><b>Audit Objective #2:</b>  <b>To assess the effectiveness of mechanisms and plans in place to help secure sustained funding and support for Perimeter Institute.</b></p>	<p>Criteria 2.1: There is ongoing and transparent communication of PI's objectives and results to key external stakeholders.</p> <p>Criteria 2.2: Plans and strategies have been developed and implemented to help secure sustained federal, provincial, and private sector support for PI.</p> <p>Criteria 2.3: Expected outcomes (at the aggregate level) are monitored, communicated and reported on a regular and timely basis.</p>
<p><b>Audit Objective #3:</b>  <b>To assess the efficiency and effectiveness (including cost-effectiveness) of PI's management structure and operational practices in fostering scientific innovation and research results in accordance with PI's mandate.</b></p>	<p>Criteria 3.1: PI's structure and working environment is effective in supporting multi-disciplinary approaches to research.</p> <p>Criteria 3.2: Procedures are in place to enable a cost-effective and timely dissemination of research results to key stakeholders.</p> <p>Criteria 3.3: Partnership and collaboration opportunities are consistently identified and managed across PI.</p> <p>Criteria 3.4: The results of partnership and collaboration activities are monitored and lessons learned are identified and acted upon.</p>
<p><b>Audit Objective #4:</b>  <b>To assess the efficiency and effectiveness (including cost-effectiveness) of outreach processes and practices in promoting the value of PI and theoretical physics to target audiences.</b></p>	<p>Criteria 4.1: Mechanisms are in place to define and identify key target audiences and related needs / interests.</p> <p>Criteria 4.2: Outreach products and programs are designed and implemented to effectively reach defined target audiences and communicate the value of theoretical physics.</p> <p>Criteria 4.3: Mechanisms are in place to assess and monitor the effectiveness of outreach activities and take corrective action as necessary.</p>

The audit planning phase was completed between May and June 2010 and the plan was shared with Industry Canada prior to its implementation. The audit criteria focus on assessing the efficiency, economy and effectiveness of PI's management of Industry Canada funds. The scope of the audit covered PI's management controls, processes, and practices related to the audit objectives identified in the table above, with a focus on the most current activities and practices in place within PI.

Our audit fieldwork included the conduct of the following: interviews with over 16 representatives of PI administrative staff, faculty members, and members of the Board and SAC; interviews with 5 external stakeholders; and, the examination and analysis of documentation of relevance to each of the audit objectives, including: the examination of a sample of partnership agreements and supporting documentation; examination of documentation supporting a sample of recruitment approvals for Associates, Faculty appointments, Tenures, Postdoctoral Fellows, and Perimeter Scholars International (PSI) students; examination of a sample of outreach and marketing material; and documentation supporting relevant management processes and practices. Our work also included the review and analysis of the results of surveys of key PI stakeholders, including researchers, department heads, PI Faculty members, Postdoctoral Fellows, PSI students, and an expert panel, conducted in conjunction with the performance evaluation that was performed concurrently with the audit.

Our work was limited to, and our recommendations are based on, the procedures conducted. The findings and recommendations should be considered in the context of the procedures performed. We relied on information and representations of management and others for the completeness of background information provided.

# Observations and Recommendations

Our observations from the audit fieldwork and related recommendations for improvement are categorized below under each of the four audit objectives as stated in the performance audit plan.

## 1) Recruiting

The achievement of PI's mission to explore foundational issues in theoretical physics at the highest levels of international excellence and to create outstanding educational and research opportunities for graduate students are, in part, dependent upon being able to attract and retain the best and most innovative individuals. In doing so, PI must compete for candidates from leading educational institutions around the world. As part of the audit, we examined the strategies and practices in place to attract and retain a world-class and leading calibre of research talent required to support PI's mandate. Our audit focused on examining the most current practices in place for Junior Faculty, Tenure Faculty, Associate Faculty, Postdoctoral Fellowships, and Perimeter Scholars International positions.

***We found that mechanisms are in place to promote and attract PI to the world's best research talent.***

PI has identified a number of recruitment targets as part of its Five Year Plan. These targets include an eventual steady state recruitment goal of 25 Faculty members (there are currently 14), 25 Associate Faculty members (there are currently 12), 50 Postdoctoral Fellows (there are currently 43), 60 PhDs (there are currently 20), and 50 PSI students (there are 31 students in the 2010-2011 year). While PI has established these quantitative recruitment targets, their candidate selection continues to be focused on selecting the best candidates. Candidate requirements and available pools of candidates differ depending upon the position category. As a result, PI has tailored its recruitment approach to differentiate between students applying for the PSI program and those with PhDs applying for Faculty, Associate Faculty, and Postdoctoral Fellowship positions:

- **At a PhD Level** - PI's graduate program offers students advanced research training and excellent opportunities to interact with top physicists, both resident and visiting, from around the world, a key element supporting candidates' attraction in coming to PI. Students are typically identified by PI Faculty, who all hold adjunct faculty positions at nearby universities that allows them to recruit and supervise graduate students. Because PI is not a degree granting institution, PI's graduate students are registered at and receive their degree from a partnering university where a PI Faculty member has an affiliation. With the implementation of the PSI program, PI intends to actively recruit and retain its top PSI students to further their PhD studies at PI in the future.
- **At a Master Student Level (PSI Program)** – PI promotes the PSI program to potential students by sending posters and brochures to over 300 international institutions. These materials highlight the opportunities provided by the PSI program and its requirements. Recipient institutions are requested to post the materials within their departments, and professors are asked to recommend qualified students to the PSI program. Opportunities are also consistently promoted through the PSI dedicated website, which clearly defines the benefits of attending PSI and the program's requirements. As stated above, PI plans to retain top PSI students for PhD research at PI.
- **At a Postdoctoral and Faculty Level** – PI promotes opportunities for Junior Faculty, Associate Faculty, and Postdoctoral Fellowship positions to researchers with PhDs through e-mail communications of available position(s) to over 800 research centers and academic institutions around the world, along with targeted recruitment efforts for specifically identified candidates. These communications are supplemented by advertisements posted in publications and websites that are commonly accessed by world class physicists and researchers, including the websites of other universities and institutions. In addition, Canadian universities that partner with PI to jointly attract mutually beneficial candidates also promote available Associate positions through their scientific network, their own website, and other means as they consider necessary. Through the recruitment process, a short-list of candidates are invited to the institution to meet PI's researchers, observe



the environment, and conduct a lecture that will be recorded and posted to the Perimeter Institute Recorded Seminar Archive (PIRSA). This provides potential candidates with an opportunity to experience PI and its structure, culture, and philosophy first hand. PI's website also includes promotional booklets providing an overview of the Postdoctoral Fellowship Program and research opportunities at PI.

In general, PI has seen an increased level of interest in its programs over the past five years, which supports the effectiveness of its recruiting efforts, the attractiveness of the organization to potential candidates, and each respective program's reputation. For the Postdoctoral Fellowship Program alone, PI has seen an increase of 117 or 30% in the number of applicants over the past three years, and now receives over 500 applications per year for a small number of available positions. In recognition of the high level of competition faced by PI from internationally renowned institutions, management purposely extends more offers than required to fill its annual recruitment targets, as it is acknowledged that not all offers are likely to be accepted. This is particularly relevant for candidates in the String Theory field, where the greatest international competition exists. As a result, the average level of offer acceptance has varied between 38% and 50% over the past three years. It is important to note that, despite the increase in the number of Postdoctoral applications being submitted, PI has decreased both its recruitment targets and the number of offers it has extended in each of the past three years. This is a reflection of a conscious effort to continue to increase the quality and calibre of Postdoctoral candidates accepted by the Institute. Postdoctoral recruitment statistics from the past three years are provided in the table below.

**Table 1: Postdoctoral Fellowship Applications**

	2010	2009	2008
Number of Applications	511	483	394
Increase over Prior Year	6%	23%	23%
Number of Offers	24	26	36
Percentage of Offers per Applications Submitted	4.7%	5.4%	9.1%
Target Positions	10	12	15
Number of Acceptances	9	13	15
Acceptance Rate	38%	50%	42%

PI has had a highly successful track record in recruiting Junior Faculty, which form a pool of talent from which PI can continue to build its future senior Faculty cadre. PI's strategy for Junior Faculty members is to intentionally target candidates demonstrating significant promise early in their career. In this manner, PI aims to target and recruit Junior Faculty candidates before they become established and more attractive to other competing institutions. PI is willing to take on risks related to the fact that the candidates may not have a proven track record in anticipation of PI realizing high rewards in the future as these young people grow into prominent scientists. This strategy has enabled PI to recruit 6 Junior Faculty over the past two years, with only one offer being declined, as illustrated in the table below:

**Table 2: Junior Faculty Applications**

	2010	2009	2008
Number of Applicants	47	73	38
Number of Offers	4	3	0
Number of Acceptances	4	2	0
Number of Declines	0	1	0

In addition, over this period PI has appointed two Associate Faculty of whom one is tenured and the other is non-tenured in their respective universities. Two offers were made and two were accepted for these positions. Finally, Perimeter has recently appointed one new Senior Faculty member, and this was the only offer made during this period.

PI has also attracted international leading researchers for extended research visits to PI through its Distinguished Research Chairs program. The program provides researchers with the opportunity to come to PI to research in the absence of administrative and operating tasks required at their home institution. The attractiveness of this program to internationally renowned researchers is evident in the high acceptance rate, with 20 out of 21 offers being accepted since the program was initiated. The program itself is also very cost-effective for PI, as leading researchers are brought to PI for a modest honorarium and are allowed to focus purely on scientific research. This program also heightens the attractiveness of PI to regular recruitment candidates in that it enables students and resident researchers to interact with world leading scientists.

Results of our interviews with internal and external stakeholders have consistently acknowledged the attractiveness of PI to the world's most promising researchers and talent. This is supported by the results of our survey, in which the vast majority of survey respondents indicated that PI has been successful in attracting and recruiting researchers of the highest international calibre to a great or very great extent. In addition, the calibre and world-renown of the Institute Director provide further evidence of the attractiveness of PI on the international stage.

In addition to its formal recruiting processes, PI has a geographically dispersed research network enabling multiple points of contact between its researchers and the scientific community at large. This network provides an efficient and effective means by which the benefits of PI can be communicated directly to the world's best talent. Positions offered under the Distinguished Research Chairs program and Affiliate and Associate Faculty openings attract candidates who are shared between PI and other institutions (both national and international), most recently including the world-renowned physicist, Stephen Hawking.

Further expanding the geographic reach of its researchers, PI enables researchers to sponsor short-term visitors at the Institute, with each researcher eligible to invite one to two collaborators for periods of three to six weeks per term. Results of our interviews with Faculty members indicate that invitations for short-term visitors are often strategic, intended to offer future Faculty candidates the opportunity to experience the benefits of PI firsthand. PI researchers also travel to various conferences and seminars where they represent PI on the global stage. These direct contacts are key mechanisms through which the benefits of PI are communicated to targeted and potential candidates and recruits.

In addition to targeted recruitment activities, general communications and promotion of PI events, receptions, and lectures, along with mediums, such as the Perimeter Institute Recorded Seminar Archive, provide further mechanisms through which potential candidates become aware of the calibre of PI's research activities and structure.

***We found that processes exist and are followed to enable an objective and comprehensive assessment of the quality of recruitment candidates and to prioritize and approve recruitment decisions.***

The recruitment process for all positions within PI is generally initiated by the submission of a formal application from the candidate, including a resume and at least three letters of recommendation. In addition to this baseline documentation, Postdoctoral Fellowship applicants are required to submit a research statement, applicants for Faculty positions are required to submit a listing of research and teaching accomplishments and research plans, and applicants for Tenure positions must submit research philosophies and a service statement. With the exception of applications for Tenure promotions, all applications are submitted through PI's website. Applicants are assessed as follows:

- **Postdoctoral Fellowship positions** – Postdoctoral Fellowship candidates may apply through the general public application process or may submit an application upon being identified and recommended by one of PI's research areas. All applicants are assessed by the Postdoctoral Selection Committee, made up of researchers from each of the research disciplines at PI, the Institute Director, and the Academic Programs Director. Hiring decisions are based on consensus after the Committee members evaluate each candidate's application and the results of their interactions with PI during the application period, including meetings with Faculty members and participation in lectures. While it is our understanding that candidates are evaluated against a number of elements in practice, the primary documented selection criterion refers to assessing the extent to which candidates demonstrate strong promise in making discoveries.
- **For Junior Faculty positions** – Recruitment efforts for Junior Faculty are led by the Institute Director. Support is provided by Search Committees that are formed, as required, with a Chair appointed by the Institute Director. Potential applicants are invited to PI to interact with PI Faculty. Successful candidates are endorsed by Faculty and resident Associates, prior to being evaluated by the Scientific Advisory Committee and then forwarded on to the Board for final approval. Recommendations from the Faculty to the SAC are compiled in a report that documents the process used and the overall decision.
- **For Tenure positions or promotions** – Tenure positions may be awarded directly when an applicant is hired or may be awarded through the promotion of a junior researcher in their 6<sup>th</sup> year or earlier with the consent of the Institute Director. Tenure decisions are initially evaluated by a Tenure Committee, then the SAC, prior to going to the Board for approval. The Tenure Committee is made up of three to five Senior Faculty members and at least one non-academic member of senior management. Prior to the start of the evaluation, the researcher may challenge the composition of the committee. Decisions are made by the Tenure Committee by secret ballot. In forming their decision, the Tenure Committee considers how candidates have contributed to PI and also the quality of their research and their ability to continue to perform at a high level going forward. Input on the candidates is also obtained from external referees, that, with the exception of three suggested by the candidate, are selected by the Institute Director. Recommendations from the Tenure Committee to the SAC are compiled in a report that documents the process used and the overall decision.
- **For Associate positions** – Both PI and the host University are involved in the selection of the candidates for their initial 7 year term. Renewal for further terms as Associates at PI is at the discretion of the institute while the university follows its own tenure process. At PI, all Associates must be interviewed by PI representatives and endorsed by the PI Faculty, Institute Director, and Scientific Advisory Committee prior to being approved by the Board of Directors. The Associate must also meet the host University's selection requirements, which may be similar to that of PI's. For Associate renewals, a Review Committee and the SAC will evaluate the candidate prior to the candidate being approved by the Board of Directors. Documented support for Associate hiring and renewal decisions are retained by PI in reports to the SAC, and follows the same general process as that for Faculty recruitment (i.e. the process used and the overall decision is documented and presented to the SAC.)
- **For PSI positions** – PSI applications are reviewed for completeness by the Academic Program Coordinator, prior to being sent to the Admissions Committee for evaluation. In the latest round of evaluations, the Admissions Committee was made up of the Academic Program Director, an Affiliate Professor from the University of Waterloo, and three Faculty members from PI. Applications are divided between members of the group alphabetically and members are provided with pre-defined evaluation criteria and asked to rank applicants as accept, decline, or further discussion needed. The Committee then meets to discuss the applications and come to a consensus on the final listing of students to be accepted. In the current year, e-mail

communications between committee members were retained to evidence the initial decision making process, with the exception of the initial ranking from the Chair.

In addition, and as mentioned previously, PI appropriately does not look to fill positions to simply meet numerical targets, but rather focuses on extending offers to only individuals deemed to be of the quality sought by PI.

***Observation #1: Inconsistencies were noted in the extent to which formal documentation supporting the full rationale behind recruitment decisions is retained.***

Although documentary evidence exists to support most hiring decisions and approvals, opportunities to improve the nature and depth of this documentation were identified. Based on our examination of a sample of hiring decisions from the most recent fiscal years, we observed the following:

- **PSI** – We observed that PI retains e-mail correspondence regarding evaluation criteria and guidance as well as initial rankings for PSI students from the Admissions Committee members. However, the initial rankings of candidates requiring “further discussions” and those not accepted by the Chair of the Committee and evidence supporting subsequent discussions of applicants initially ranked as requiring “further discussion” by the Committee was not retained. To strengthen PI’s records of decision and approval, information retained could be expanded to include evidence of these discussions.
- **Faculty Hires and Tenure Promotions** – We observed documentation on file supporting Faculty hires and Tenure promotions, including reports to the SAC from Search Committees and Tenure Committees outlining the process followed to recruit individuals and the rationale for recruitment decisions. This provides excellent evidence supporting the initial candidate evaluation process. Based on our examination of a sample of hiring decisions, we noted that information available to support the SAC’s rationale for two Tenure promotions was well documented, as the discussion regarding these cases occurred during an SAC annual meeting. On the other hand, for the two Faculty and one Associate recruitment decisions examined, where the hiring did not coincide with an annual SAC meeting, the documentation on hand to support the SAC’s decision consisted of an e-mail identifying the individuals on the SAC that endorsed the candidate, but had no documented supporting rationale for the decision. While it is our understanding that SAC members did discuss these candidates through e-mail communications with one another, this supporting documentation was not on file. It is our further understanding that, in light of the fact that the SAC is an arm’s length body whose role is to provide advice only and due to confidentiality concerns, documentation over and above the listing of SAC endorsed candidates was not provided by the SAC. Requesting the SAC to retain e-mails and/or other documentation that support the rationale for their recommendations will help to evidence that individuals are being consistently considered throughout the process and may also help the Board better understand the rationale behind any differences in recruitment recommendations between internal committees and the SAC.
- **Postdoctoral Fellows** - Our examination of documentation available for the 2009 and 2010 recruitment of seven Postdoctoral Fellowship positions indicated that there is limited evidence retained to support the hiring rationale. Documentation on file included e-mail exchanges and agendas that listed candidates discussed and, in some cases, how these candidates were brought forward to the Postdoctoral Selection Committee (e.g. if recommended through a research area) and a reference to whether the candidates should be issued offers in the first or second rounds. However, this type of documentation evidencing candidate discussion was available for only two of the seven applicants in our sample. As such, there are opportunities to strengthen the documentation of Postdoctoral Selection Committee discussions to enable better consistency and transparency in Postdoctoral Fellowship recruitment decisions.

**Recommendation #1: Management should strengthen the consistency and nature of documentation retained in support of hiring decisions for all candidates, including clearly defined candidate assessment criteria.**

**Management Response:** *Although management agrees with the recommendation, we would like to stress that due diligence, thorough deliberation and extreme care is in fact practiced in all recruitment processes. We are confident that our methodology ensures that only the highest quality candidates who are the best fit for the institute are hired. Nonetheless management agrees that as the institute grows, more formality is desirable and will review recruitment procedures and make modifications to acquire and retain additional written documentation to evidence the process.*

***We found that mechanisms are in place to identify, implement, and continuously improve PI's working and living environment to enable the attraction and retention of the world's best research talent.***

The attractiveness of PI's working and living environment is considered to be a critical success factor in its ability to attract talent from other world-class institutions in more geographically recognized centres. This is achieved through strategies related to PI's organizational structure, physical and operating environment, compensation, and researcher support.

A cornerstone of PI's philosophy and strategy is the ability to provide researchers with opportunities to collaborate in a multi-disciplinary manner to maximize the opportunity for scientific breakthroughs. PI has effectively created a structure and operating environment to support this philosophy, which is discussed further under the "Structure" section of this report. This structure includes a high ratio of Postdoctoral Fellows to Faculty when compared to other leading research and academic institutions, thereby enabling a wide range of freedom for Postdoctoral Fellows to explore their own ideas in their own manner.

In addition to its operating structure, PI provides its researchers with opportunities to participate in a variety of colloquia, workshops, and conferences. PI further provides significant opportunities for interaction with world renowned physicists and researchers through the Distinguished Research Chairs Program, under which the world's leading scientists are resident at PI for one to two months per year, which further adds to the attractiveness of the PI experience. PI's compensation and awards of merit are benchmarked with other leading institutions to help ensure its financial offerings remain competitive.

Recognizing that candidates must leave other cities and countries from around the world to join PI, the Institute has implemented formal social programs to assist researchers and their families in transitioning to life in Waterloo. These programs start with the Welcome Back BBQ, which includes career counseling, lodging support, and an outline of other activities. Throughout the year, PI hosts an average of one social activity per month, which provides opportunities for researchers and their families to connect on a social level and to learn more about the attractions and events in the local community. Past social events have included movie nights, luncheons, and excursions to local attractions and events. In addition, PI also offers an Event Horizons program that aims to bring a broad spectrum of arts and cultural events to Waterloo. PI's active social events and hosting programs are critical in helping attract researchers and their families to PI, particularly given the fact that primary reasons cited for PI offers not being accepted are family-related (e.g. spouse or partner not willing to relocate). Throughout the audit, we observed evidence supporting PI's success in attracting candidates with counter offers from other institutions that included PI's provision of assistance in finding employment opportunities for the candidates' spouses and its overall commitment to helping new researchers and their families feel welcome and "at home" at PI.

Regardless of the type of position an individual holds at PI, to facilitate scientific collaboration at all levels, scientists are encouraged to participate in colloquia, social events, and other collaborative opportunities in relaxed settings. Further encouraging discussions, PI's facilities include a number of different collaboration areas with blackboards present throughout the institution where ideas can be explored on an ad-hoc basis. Each research group also holds a weekly meeting where researchers are able to discuss current projects, new results and share ideas. Researchers benefit from a research-related budget and the ability to invite short-term collaborators through the Short-Term Visitor Program, to lead or attend workshops and conferences, and to promote collaboration with research institutions afar.

The strength of PI's working environment and structure is evident in its high retention rate, its ability to continue to attract renowned international physicists, and the increasing number of applications it receives each year at all levels. Our survey results further support the quality of the PI environment in attracting and retaining quality talent: 88% of researchers surveyed stated that the overall research environment at PI fosters and supports cutting edge research, and 74% stated that PI's research environment was better or much better than that of the researchers' home institutions. The most commonly cited features contributing to this positive assessment included the high level of flexibility and freedom provided to researchers to pursue novel research ideas and methods, an excellent facility design that encourages high levels of interaction with top talent both within each researcher's field and in complementary fields, financial support for travel, an active seminar and workshop series, and the visitor program.

***PI employs a number of mechanisms to assess researcher and student satisfaction and take corrective action on a timely basis.***

The primary mechanism for obtaining feedback on PI satisfaction levels is the use of anonymous surveys. PI administered an organization-wide survey to all personnel in 2008. Although the response rate from the scientific personnel was low, the findings from scientific respondents were consistent in identifying a strong personal connection with PI and a strong sense of teamwork. Our survey results identified that, overall, 81% of researchers and 77% of students were satisfied with their experience at PI to a great or very great extent.

In addition to surveying staff, PI has also gathered feedback from PSI students and tutors on their satisfaction with the PSI program, including tutor performance. The feedback was consolidated based on a report from a self-appointed group of students and a survey of students and tutors. In direct response to the feedback obtained, the PSI course schedule was revised in the second year of the program to reduce the course load and provide more time for students to absorb and work through course material.

Feedback from Postdoctoral Fellows was gathered through a Postdoctoral Feedback Questionnaire administered in 2008. While PI has reviewed the results from the Postdoctoral Feedback Questionnaire, the information gathered was general in nature and, as a result, did not result in any specific changes to PI programs. PI has recently re-designed the Postdoctoral Feedback Questionnaire to enable more specific feedback and to help generate more responses from selected participants. It is our understanding that the results of this feedback will be considered in identifying any required changes to PI's structure and programming. A Postdoctoral Fellow Mentoring process has also been recently introduced. Under this program, each Postdoctoral Fellowship position is supported by two mentors: one from their disciplinary area of focus, and the other being an interdisciplinary member. Comments and feedback received from the mentees are provided to the Academic Programs Director, who consolidates and reports the information to the Institute Director to retain the anonymity of the source of each comment. Every Postdoctoral Fellow is required to participate in this process. This program is expected to not only provide support to new researchers in what is generally seen as their most innovative yet stressful years, but also to provide an important means by which Postdoctoral satisfaction can be proactively monitored and responded to as required.

To monitor the effectiveness of its social activity programming, management tracks the number and type of staff attending social events, including number of family members who attend. This information is used to help plan future events and assess the relative attractiveness and uptake on current programming. It is our understanding that feedback on event satisfaction will be further assessed through a formal survey.

## **2) Funding and Support**

Since its inception, PI has existed through a unique funding structure of public-private partnerships through which government, private industry, and philanthropists have provided financial support for PI's operations. PI's ability to continue to secure additional funding from these various stakeholder groups is influenced, in part, by the extent to which its objectives align with the priorities and interests of funders and its ability to continually demonstrate the impact and benefits of its operating activities. We examined the practices and mechanisms employed by PI to obtain ongoing support among key stakeholders in both the private and public sectors.

***We found that mechanisms are in place to support the communication of PI's objectives and results to key stakeholder groups in a transparent and cost-effective manner.***

PI's strategic objectives and priorities are formally defined in its Five Year Plan – Building on Success. This plan, finalized in 2009, describes the key activities and expected results to be achieved by PI over the next five years in support of its mission. The plan is publicly available on the PI website and is further used as a point of reference for discussions with stakeholders in describing the PI vision.

PI's annual reports are a formal means by which PI's results and achievements are highlighted through both qualitative and quantitative measures. Annual reports are publically available on the PI website, as are PI's annual



reports provided to Industry Canada, in both official languages. PI also submits formal corporate plans to Industry Canada on an annual basis that define specific priorities and expectations for the year by strategic objective.

In addition to formal corporate reporting, PI has an award winning outreach program, through which the activities of PI are well communicated to a wide range of stakeholder groups, including the general public. Through its outreach programming, PI hosts a number of events geared towards raising awareness of the importance of theoretical physics in the general public, including its Public Lecture Series and other large events, such as the Quantum to Cosmos festival, a pre-eminent event held during the federal government's National Science and Technology Week. Often PI's general public events are delivered with support from external corporate sponsorships, allowing PI to further leverage its funding while increasing its exposure. Further, in generating interest in science among the general population, PI is successfully promoting its organization to a large pool of potential future funders and supporters.

The success of PI's efforts in communicating its objectives and results to a wide range of stakeholders and generating interest in its operations is further supported by the publication of positive articles on PI in two separate editions of Maclean's magazine within the past six months as well as extensive coverage in national and international media, the occurrence of two separate visits and speeches by the Prime Minister to PI's facilities in the past year, and popular public lecture broadcasts on (primarily) TVO, as well as some select talks on Rogers, Rogers Digital on Demand, CPAC, and the Discovery Channel.

***We observed that plans and strategies have been developed and implemented to help secure incremental support for PI from various stakeholder groups.***

Since its inception, PI has been successful in generating private sector funding. Between 2007 and 2010, PI received almost \$100 million in private donations. Of these donations, \$90 million came from two major private donors who have provided significant donations since PI's inception. As illustrated in the table below, PI has generated close to 55% of its total funding from private sector sources.

**Table 3: PI Committed Funding by Source**

Funding Type	Pre-2007	2007	2008	2009	2010	Total	Percentage of Total
Industry Canada		\$50,000,000				<b>\$50,000,000</b>	<b>12.74%</b>
Other Federal	\$32,410,600	\$60,700		\$92,100	\$10,421,427	<b>\$42,984,827</b>	<b>10.95%</b>
Other Private Institutions		\$18,574	\$52,126	\$655,130	\$46,000	<b>\$771,830</b>	<b>0.20%</b>
Private Donations	\$121,625,000	\$241,034	\$50,005,164	\$40,087,010	\$625,753	<b>\$212,583,961</b>	<b>54.16%</b>
Provincial/ Municipal	\$74,252,000	\$55,086	\$74,904	\$970,000	\$10,425,417	<b>\$85,777,407</b>	<b>21.86%</b>
Private Sector Sponsorships				\$100,000	\$242,500	<b>\$342,500</b>	<b>0.09%</b>
<b>Total Funding</b>	<b>\$228,287,600</b>	<b>\$50,375,394</b>	<b>\$50,132,194</b>	<b>\$41,904,240</b>	<b>\$21,761,097</b>	<b>\$392,460,525</b>	

While PI has been effective in fundraising from its existing network, PI is actively seeking to continue to expand its network for the long-term sustainability of the Institution through its “Expanding the Perimeter” strategy. This strategy is largely being implemented through the work of the Development team, established in 2009. The team has a staff complement of 4 full-time resources headed by Jon Dellandrea, who has been credited with raising over \$1 billion for the University of Toronto, as their strategic advisor. It is tasked with helping to achieve the “Expanding the Perimeter” goal of securing \$200 million in private sector commitments (for payment over the next 10 years) by building relationships with philanthropically inspired individuals, corporations, and foundations capable of major gifts. As a first step, the Development function has been actively focused on establishing the Expanding the Perimeter Leadership Council, a group of international community leaders who will volunteer their time, connections, and resources to support the success of PI’s fundraising efforts. To date, there are 19 committed individuals who, with the exception of one individual in New York City, are centered in southwestern Ontario. They plan on officially launching the group with an orientation session this fall and expanding their focus to attract more international members.

Based on the results of our interviews with public and private sector stakeholders, we received consistent feedback supporting a high level of satisfaction and commitment on the part of external stakeholders regarding the work being performed by PI. In addition, we received consistent feedback supporting the level of engagement initiated by PI to understand stakeholders’ goals and priorities and align PI activities with these priorities on both a research and outreach level.

On a research level, PI has developed partnerships with Canadian and international institutions to leverage faculty funding available to institutions while providing a venue through which researchers can connect to collaborate and further research in their field. This is achieved through research related subsidies for PI’s Short-Term Visitor Program, Sabbatical Program, Distinguished Research Chairs Program, and Affiliate Member positions and also through the receipt of proportionate funding for Associate Faculty positions. This funding strategy is not only cost-effective, but is mutually beneficial to both PI and the participating institutions as the collaboration enables both institutions to further their own research. These programs are also enabling PI to become a second home to many leading scientists around the world.

***We found that PI has formal processes in place to measure and report on its performance, internally and externally.***

On a quarterly basis, administrative areas within PI report on progress against budgeted activities and the annual corporate plan to the Chief Operating Officer (COO). These reports mainly focus on financial results and the status of key cost drivers, such as projects. In some cases, the reports are supplemented with documentation outlining the group’s key activities over the year. In addition to this formal reporting, the Chief Operating Officer holds regular meetings, in some cases at a bi-weekly frequency, with each Director to discuss progress in their respective areas of responsibility, as well as regular meetings with the Institute Director to discuss the progress of PI as a whole.

The Institute Director oversees the activities and performance of resident researchers, and serves as a mentor to all Faculty members. Beginning in the summer of 2009, all Faculty were required to develop a web-page identifying their main research activities including documents, publications, and conferences. Researchers are required to keep these up to date and the Institute Director will periodically reference them to monitor the status and progress of their activities. The Institute Director also meets with each resident researcher one-on-one on at least an annual basis. Beginning in this fiscal year, the performance management process has been enhanced to enable merit pay that is directly tied to and based on researcher performance.

On an annual basis, PI formally measures and reports on progress against strategic objectives achieved during the year in their Annual Report and also through their Annual Report to Industry Canada. As mentioned previously, both of these reports are available publicly on PI’s website and are provided to funding partners. In addition, PI’s annual Corporate Plan reports on the progress made against strategic objectives, the achievement of targeted outcomes in each area, and the next year’s plans, priorities and targets. The plan is submitted to the Minister of Industry and the Minister of State (Science and Technology).



The Institute Director reports quarterly to the Board on progress against key Institute initiatives and activities, such as hiring plans, policy and program changes, and major events. The Director also provides an annual report to the SAC providing details on key results achieved by disciplinary area and by program. This report includes statistics on hiring, conferences held and attended, publications issues and cited, and other measures of relevance to PI's mission. The SAC, in turn, reports annually to PI to provide its perspective on PI's progress against scientific objectives and its policies for the consideration of management and the Board.

***Observation #2: Internal performance reporting has been primarily financially-based rather than outcomes-based, and has not consistently included information on performance measures or targets.***

Based on our examination of a sample of historical Quarterly Progress Reports, we observed strong reporting on financial results against budget by functional area, but inconsistent information and reporting on the achievement or progress towards the achievement of non-financial goals and targets. It is our understanding that in addition to this formal reporting, the COO holds regular meetings with individual Directors through which the performance of administrative functions is discussed, as well as with the Institute Director to discuss overall PI performance. Similarly, the Institute Director holds regular meetings and has frequent interactions with Faculty through which progress against scientific objectives is discussed. However, as the organization continues to grow, the implementation of more formal and consistent regular reporting on performance against targets, both administrative and research-based, may be of benefit to management in proactively identifying risks and areas of challenge and in communicating and monitoring the achievement of priority goals and objectives of interest to key stakeholder groups. Management has recognized the need to strengthen its internal performance reporting, and has developed templates that require the reporting of both quantitative and qualitative information, including information on risks and challenges.

**Recommendation #2: It is recommended that PI continue to enhance its existing reporting process by implementing regular performance reporting that incorporates non-financial performance measures and progress against objectives for both administrative and research activities.**

**Management Response:** *Management agrees with the recommendation. Changes to this effect were in fact implemented in September 2010 as management recognized the need for more formal documentation to complement the regular evaluation meetings. A core template was established to ensure consistency of reporting on the achievement of performance measures on a quarterly basis. It is important to note that informal evaluation of PI's performance measures has always been rigorously conducted. However, given the rapid growth of PI, the establishment of formal policies and procedures surrounding this evaluation process had not been developed at the same pace with which the Institute has developed.*

### **3) Structure**

PI has grown to include over 70 resident researchers who are involved in day-to-day operations and has hosted hundreds of international researchers for collaborations and workshops, since its inception. Key to supporting its mission and areas of strategic priority is PI's ability to provide an environment that supports the generation of innovative ideas and results from the resident researchers and visitors. We examined the management practices in place to help ensure that PI's management structure and operational practices help foster scientific innovation and research results.

**Key elements of PI's operating structure and working environment are effective in supporting multi-disciplinary approaches to research.**

PI is led by an Institute Director, who ultimately has responsibility for ensuring that PI's objectives are met and for developing and implementing the Institute's strategic direction. In addition to overall responsibility for PI, the Institute Director directly oversees the work of PI's scientists and scientific programming. PI's daily operations and administrative support is led by a Chief Operating Officer who reports directly to the Institute Director.

PI is governed by a volunteer Board of Directors, which includes two sub-committees – an Investment Committee and a Finance and Audit Committee – to provide specific oversight with respect to the financial management of PI. The Board is further supported by a Nominating Committee, responsible for making recommendations regarding the appointment of new Board members and the renewal of existing Board members. The structure of the Board was reviewed in 2007, at which time Board candidate profiles, Board composition, and administrative matters regarding Board committees and meetings were documented. In particular, the Board is expected to have at least one member with experience in the following areas: science; finance; government relations; academia; business; fundraising; and governance. The Board and management are supported by the SAC, an advisory committee made up of eminent international scientists. The SAC is intended to advise the Institute Director and the Board on matters of scientific policy, appointments and renewals of PI scientific staff, and annual performance reviews. As such, the SAC has no formal decision making authority, but rather exists to provide an independent perspective on PI's activities, particularly with respect to the extent to which scientific excellence is achieved through PI operations. This structure provides PI with access to international expertise, while not compromising its independence in decision making, and is consistent with the structure followed by other private sector research-based organizations. As recommended in the 2007 review of the Board, we encourage management to continue to re-visit the stated role, composition, and mandate of the SAC and Board from time to time to help ensure that its governance structure continues to be appropriate as the organization grows.

A core component of PI's vision is to have a single interdisciplinary community to generate the best ideas and next big scientific breakthrough, as defined within its Five Year Plan. Given this defined strategic direction, PI's organizational structure and operating style reflects a multi-disciplinary approach, including the use of multi-disciplinary committees for research related decisions, such as the Postdoctoral Selection Committee, Admissions Committee (for PSI students), Visiting Researcher Committee, Tenure Committee, and committees used for Faculty hires.

As indicated previously, PI facilitates collaboration among researchers through weekly colloquia, weekly meetings to discuss progress in research areas, seminars, conferences, and facilities that include a number of collaboration areas. Through monthly Faculty meetings, resident researchers provide input on content for seminars and colloquia, along with candidates for recruitment, and are informed of other administrative activities and key collaborative activities used to integrate the team with new members regardless of their discipline. Additional weekly research meetings held for each discipline are open to all resident researchers who would like to attend and speak to a group of peers on their ideas.

The effectiveness of PI's operating structure in promoting collaboration has been independently reported, most recently in the September 27, 2010 issue of Maclean's in an article entitled *Mind-bending mysteries at the Perimeter Institute*, in which it is noted that Perimeter is unique in the extent to which complimentary sub-disciplines are put together in ways designed to encourage co-operation and confrontation of ideas and approaches.

Physically, the Institute is designed to encourage collaboration through the incorporation of open concept areas throughout its facility. Its main building in Waterloo has won a number of design awards including the national Governor General's Medal for Architecture in 2006. This building includes two seminar rooms – Bob and Alice – which can accommodate 60 and 40 researchers respectively and a 205 seat Mike Lazaridis Theatre of Ideas to encourage communication, discussion, and collaboration. Suggestions on facility design improvements that could further facilitate collaboration and research are being sought from Faculty members in the design of its new building. A General Design Team has been formed with PI to help ensure that researcher's insights are being considered.

As mentioned previously, PI's physical environment and operating structure are considered to be critical factors in attracting and retaining top quality talent based on the results of our survey. In particular, 82% of researchers surveyed indicated that the freedom to pursue novel research ideas and methods was of great or very great importance in their decision to become involved in PI, 83% indicated that these conditions are actually in place in PI, and 67% indicated that this feature contributed to supporting cutting-edge research to a great or very great extent. 77% of this same group of respondents identified that opportunities to interact with top people in their field of research was a key attraction and was found to be in place within PI, while 63% indicated that this feature

had contributed to their research program to a great or very great extent. These results positively support not only the attractiveness of PI as a research institution but the value of PI's structure and environment in supporting research outcomes.

***Observation #3: PI's need for external scientific advice and guidance are evolving as the quantity and calibre of PI's Faculty continues to grow and mature.***

The SAC was established to provide the Executive Director, board and original three members of PI's Faculty with advice on scientific policy, appointments, renewals and reviews of scientific staff from the world's leading scientists. As PI's Faculty has now grown to 14 members, its size exceeds that of theoretical physics groups in most universities and its internal capacity and capabilities have grown significantly since PI's inception. In addition, as mentioned previously, the SAC plays a role in providing advice and guidance on PI's scientific staff hirings and renewals. However, given that the SAC consists of members from the world's leading institutions who may also be interested in recruiting the same candidates as those applying to PI, there is the potential for real or perceived conflicts of interest. The SAC is required to abide by PI's Conflict of Interest policy and guidelines, which helps to manage this risk. Although we observed no evidence to indicate that any conflicts of interest have occurred in the past, as PI continues to grow and attract the world's leading talent, there may be increased potential for real or perceived conflicts to occur in the future, as advice on scientific hirings is being provided by some of PI's greatest competitors. With the expansion of PI's Faculty and the strength of its internal research staff, it may now be an appropriate time in PI's history to re-visit the role and mandate of the SAC to reflect PI's growth and internal strengths.

**Recommendation #3: It is recommended that PI re-visit the role and mandate of the SAC and make revisions as necessary to reflect the needs of PI going forward while continuing to enable the SAC to perform a peer review and independent challenge role.**

**Management Response:** *Management agrees with the recommendation to continuously re-examine the SAC's role as the institute grows and will reconsider the role and mandate of the SAC in consultation with PI's Board of Directors.*

***We found that PI employs a number of mechanisms to enable the dissemination of research results to key stakeholders in a cost-effective and timely manner.***

One of the primary mechanisms employed by PI to disseminate research results is the Perimeter Institute Recorded Seminar Archive. PIRSA was developed and launched in 2008 by the Perimeter Institute as a free, searchable and citable archive of video recorded seminars, conferences, workshops, and courses sponsored by PI. The goal of PIRSA is to deliver and share the most recent cutting edge research to the international scientific community in a cost-effective and timely manner. PI's target is to post videos to PIRSA on the same day they are taken. Since its launch, the site has had over 86,362 unique visitors and over 718,952 page views. This high level of uptake has contributed to the overall cost-effectiveness of this mechanism to disseminate research results, as the total cost of the system has been \$26,500 (original cost of \$22,500 and additional administration costs of \$4,000) resulting in a cost per unique visitor of \$0.31, which will continue to decrease over time. On a weekly basis, e-mails are sent to international institutions and universities identifying upcoming courses, conferences, workshops, seminars and colloquia that their members can either attend in person or observe on PIRSA. In addition to using PIRSA to communicate with external researchers, results from our interviews indicate resident researchers also use PIRSA as a means of staying informed when they are unable to attend PI events.

The participation of PI resident researchers in writing publications and in conferences, workshops, and weekly seminars are another means by which research results are disseminated among the scientific community. In 2009-2010, PI held 196 seminars, 32 colloquia, and 15 conferences and workshops, attended by 800 scientists from around the world. The number of conferences and workshops held has decreased marginally since 2007-2008, which is consistent with one of PI's priorities as defined within the Five Year Plan, related to hosting more focused conferences and workshops, and becoming more strategic in its selection of topics for conferences and workshops by identifying new areas of exceptional promise where a conference, workshop, seminar or school is likely to have a significant outcome. PI has also increased its leveraging of the PIRSA system to facilitate

discussions and disseminate results for posting seminars and colloquia. With respect to publications, since its inception, PI researchers have produced 1,380 papers, which have attracted 26,312 citations, a rate of 19 citations per paper.

PI is well recognized for promoting and disseminating research outcomes among its key stakeholders. 83% of our survey respondents indicated that PI's seminars, workshops, colloquia and conferences had successfully disseminated research outcomes to a great or very great extent, and 77% of respondents identified the on-line access to these forums to be highly successful.

***PI's partnership and collaboration opportunities are primarily identified and managed by the Institute Director.***

One of PI's strategic goals, as defined in its Five Year Plan, is to develop collaboration agreements and partnerships to encourage scientific exchange visits, collaborations and joint activities with leading centres throughout the world in order to promote progress in research areas of common interest. Formal partnership and collaboration opportunities are generally identified through the contacts of and networking performed by PI's Institute Director, although some, such as the Centro de Fisica do Porto opportunity, are identified through resident researchers.

PI has entered into a number of formal and informal arrangements globally to formally facilitate collaboration at a research and administration level, to facilitate exchanges and support student funding, and host joint workshops or conferences. To increase collaboration with peers globally, PI has entered into a number of partnership arrangements, such as the agreement with the University of Cambridge that helps to facilitate information and researcher exchanges, and the agreement with the Centro de Fisica do Porto through which a Mathematica Summer School is jointly hosted on a rotational basis between the two institutions, PI supports the participation of up to two students in the PSI program, and joint post-doctoral fellowships will be supported. PI has placed a particular priority on trying to establish partnerships with emerging and innovative centres, such as the Centro de Fisica do Porto, so that both institutes are propelled forward by each other's energy and drive. They have also informally partnered with institutions such as the Institute for Advanced Study and Princeton University to hold joint workshops and conferences. On a more grassroots level, partnerships have been formed at the researcher level between PI and international researchers to bring researchers to PI for collaboration purposes. PI also brings researchers to the institution through the Distinguished Research Chairs Program that is facilitated at an institutional level.

During our audit, we examined a sample of seven of these formal agreements. All agreements were consistent with PI's mandate, as the collaborations enabled PI to work with international institutions to work on foundational issues in theoretical physics through current researchers or through opportunities for graduate students. Some of the arrangements, such as the agreement with the Asia Pacific Centre for Theoretical Physics, are general in nature as the agreement was generated before specific collaborative activities were defined.

Results of our interviews indicate that PI works with partners to understand needs and how they can work together for a complementary arrangement. Given the current economic climate and associated uncertainties over funding that many organizations are facing, challenges may be experienced in negotiating multi-year obligations with other institutions. In these instances, PI has chosen to leverage the relationships with these institutions to support informal collaborative arrangements while continuing to explore the possibility of implementing more formally defining relationships and agreements.

Based on our examination of a sample of quotes and feedback obtained by PI from its university and academic partners, there is a high level of consistent support for partnering with PI. In particular, partners noted the strength of PI's highly collaborative settings, unique structure, and overall experience in assisting both PI and the partner institution to attract and support world-class researchers to further the goals of both partner institutions.

In addition to partnerships for research collaborations, PI has a number of outreach partnerships to help develop, distribute, or promote outreach products. Examples of key partnerships in this area include the following:

- PI has partnered with provincial teaching organizations as well as Canadian chapters of the American Association of Physics Teachers (“AAPT”) to promote PI programs and products. In several cases, a formal memorandum of understanding exists to formalize the relationship.
- PI has developed a partnership with teachers nationally that is leveraged to develop new products, share the message of the importance and power of physics through their networks and in the classrooms, and to identify pupils who will benefit from PI’s student programs.
- PI obtains information from the Citizenship Education Research Network (CERN) to target top global teachers for Einstein Plus Teachers Workshops and global students for International Summer School for Young Physicists (ISSYP).
- PI has partnered with TVO, Rogers, CPAC and Discovery Channel over the years to show some of their key outreach material on TV, including public lectures, the Quantum to Cosmo Festival, and the Hawking Event. The first Hawking presentation on TVO drew 102,000 viewers, followed by The Quantum Tamers program with 55,000 that evening. Additional airplays on TVO and CPAC followed.
- PI partnered with CBC’s ‘Quirks and Quarks’ radio program to distribute a panel discussion about ‘The Physics of Information’. The radio program itself was estimated to reach a national audience of nearly 500,000 people with additional playbacks and podcasts generating an audience of over 1 million.

PI’s Outreach department also supports institutions in a number of initiatives that will help deliver PI’s outreach message to target audiences, such as partnering with a number of science fairs to deliver presentations or key note addresses to leverage their target audience. A representative from PI has also recently been appointed to the Board of Directors of Science and Technology Awareness Network. This will enable PI to identify further outreach partnerships nationally. Moreover, the PI representative is a longtime collaborator within the World Federation of Science Journalists, a much larger community of international science communicators, which directly links outreach activities to media coverage.

***Observation #4: Opportunities to strengthen the coordination and management of partnerships were identified.***

As mentioned above, formal partnership and collaboration opportunities are generally identified through the contacts of and networking performed by PI’s Institute Director, although in some cases, such as the partnership with Centro de Fisica do Porto, the arrangement was driven through a resident researcher’s contacts. While PI has informally identified that emerging institutions are a particular priority for partnerships, a formal partnership framework that identifies targets and responsibility for partnerships may help to better focus PI’s resources going forward. In addition, partnerships and collaborations are often informal in nature, and as such, there are no formal guidelines or procedures to enable the consistent identification, management and monitoring of these types of arrangements within PI. It is understood and acknowledged that many agreements do not involve cost sharing, but are primarily collaborative in nature. It is further understood that the process of creating formal agreements in support of all collaboration initiatives with academic institutions would likely not be accepted by the external organizations and would require time and effort that are perceived to outweigh any related risks of these arrangements. However, for organizations having strategic objectives and interests in growing partnership and collaboration activities, it is a generally accepted practice to have partnership guidelines and monitoring mechanisms in place. While it may not be necessary for PI to develop a formal agreement for every collaboration it initiates, there is merit in having documented guidelines that define the circumstances or criteria under which formal agreements are required, outline key terms and conditions to be included in formal agreements, and define expectations for tracking, monitoring and assessing the value of partnership and collaborative arrangements to inform future decision making. As PI continues to grow, the existence of more formal guidelines and reporting mechanisms may help better allocate responsibilities for initiating and managing partnerships within PI and will provide a means for oversight of PI’s progress in and value received from its partnership arrangements.

**Recommendation #4: It is recommended that PI strengthen its partnership and collaboration practices by developing and implementing relevant guidelines and reporting mechanisms.**

**Management Response:** *Management agrees with the recommendation. As part of its operational plan for fiscal year 2011-12, management will target formal partnerships that require the preparation and/or formalization of processes and procedures, and will put a plan in place for their development and implementation. PI will also continue to maximize opportunities and processes for collaborations that require a less formal procedure.*

## 4) Outreach

PI's outreach objectives and programming are key differentiators from other academic institutions that are traditionally focused on research. The outreach program allows PI to share the importance of basic research and the benefits of theoretical physics with the wider community by developing programs and educational resources for students, teachers and members of the general public across Canada and beyond. We examined the management practices in place to help ensure that PI has appropriate means in place to promote the value of PI and theoretical physics to target audiences in a cost-effective manner. Notable is the cost effective manner in which information has been efficiently scaled by digitizing content for electronic delivery, building relationships with teachers who then train other educators, and by co-producing content in partnership with broadcasters.

***We found that PI has mechanisms in place to define and identify key target audiences and their related needs and interests.***

PI's Outreach Program and Product Plan is used to determine the value of each national outreach program and product, to identify target audiences for potential product and program development, and to help ensure that outreach products and programs are consistent with the national outreach priorities established in the Five Year Plan. As an example, for the Explorations-Inspirations educational resource development and distribution strategy, the Plan defines the proposed and expected value of the product to PI, its educational partners and the Ontario and Canadian government, as well as the expected cost of the project, project assumptions, and funding sources.

To engage teachers, the PI Outreach team works with the Teacher Network to develop inspiration and exploration resources including hands-on kits and digitized offerings. PI consciously develops its Teacher Network through invitations to the EinsteinPlus Teacher's Camps (EinsteinPlus) to help maximize its reach across Canada. Teachers are exposed to PI's educational outreach offerings during the development of products and, once developed, through EinsteinPlus. This will be further supplemented by a Teacher Network Training Weekend planned for 2010-2011. Through consultations with Teacher Network representatives, feedback on PI products and services is solicited. For the major Teacher Kit exploration modules (e.g. Dark Matter, Quantum, and Planck's Constant), PI received feedback from over 45 science teachers representing every province and the Northwest Territories. This level of teacher engagement helps ensure that PI's outreach products for students meet the different educational requirements nationally while also meeting teacher and students needs and interests. Further helping to facilitate PI's understanding of teacher and student needs, the Outreach department at PI is currently managed by a former teacher.

A key portion of PI's outreach plan involves reaching the general public to stimulate interest in theoretical physics and science. To better understand the needs and interests of the general public, the Outreach group at PI has conducted surveys, at a minimal cost to PI, of attendees at general public events, including its Public Lectures and the Quantum to Cosmos Festival. For example, through the survey of attendees at PI Public Lectures, the Institute was able to enhance content and the speaker line up in subsequent years to meet audience interests. The Institute also responds to ad hoc feedback. As an example, suggestions to improve the Institute's "What We Research" section of its website, were followed up with specific focus testing among students and teachers. This feedback, plus engagement with a web education expert, led to the renewal of several web pages and the inclusion of suggested resources.



***PI's outreach products and programs are designed, implemented and monitored to effectively reach target audiences and communicate the value of theoretical physics.***

PI's outreach program has won numerous awards in recognition of its excellence. In 2008, PI's outreach department was honored with The Michael Smith Award for Science Promotion from Natural Sciences and Engineering Research Council of Canada (NSERC) for outstanding contribution to the promotion of science. It's Quantum Tamers: Revealing Our Weird and Wired Future (Quantum Tamers) Documentary Program was also nominated for two 2010 Gemini Awards and has won the Pariscience International Film Festival Prix Audace (the Audacity Prize) for best originality in subject matter and treatment, Best of Show for TV feature documentary at The Accolades in California, the Grand Jury Award for Best Documentary at the DC Independent Film Festival in Washington, and the Golden Palm Award at the Mexico International Film Festival. This documentary is now into its second year of a three year international sales cycle and, as of this date, is presently available in 60 countries – thereby sharing outreach content and branding Canada, internationally.

As an award winning outreach department, PI develops outreach products that are consistent with user's needs. Key outreach products, their target users, and their reach are identified below:

- **Public Lecture Series** – Geared toward the general public, monthly lectures have room for 600 representatives to attend live sessions that feature world-renowned researchers speaking on hot topics in science at PI. Since its inception, PI has held over 125 public lectures. The event is popular and typically sells out very quickly. As a result, PI has also made the lectures available on-line through PIRSA and using this has increased its reach to over 56,935 unique visitors since August 1, 2007 – over and above audiences generated via television.
- **International Summer School for Young Physicists (ISSYP)** – Through an application process, PI invites 40 high-school students interested in pursuing physics at a university level to attend the two week summer school on an annual basis. A sample of the content from PI's ISSYP is posted on-line for students, teachers and anyone interested in accessing the material. In doing this, PI has extended its ISSYP reach by 1,651 unique visitors at a minimal cost.
- **EinsteinPlus Teacher Workshops** – Through an application process, PI selects 40 Canadian and international teachers to attend a one-week intensive workshop where teachers learn how to convey complex information to their students.
- **In-Class Teacher Resource** – These are in-class resources developed in conjunction with teachers on a national basis that include hands-on kits and digital offerings. They include 'inspiration' content to encourage interest in science and the 'exploration' content that provides more of a deep dive into ideas. PI has developed 4 main resources including the Dark Matters Resource, Quantum Resource, Planck's Resource, and the Physics of Innovation Resource. It has distributed over 8,700 of these resources in the forms of kits, CDs, or downloads, and has estimated it has reached over 654,000 students to date.
- **Other On-line Resources** – There are a variety of on-line resources available through PI's website for teachers, students and the general public. This includes multi-media resources such as Alice and Bob in Wonderland, Meet a Scientist, Power of Ideas, Mystery of Dark Matter and associated video game, and the Physics of Innovation. PI has attracted total unique visitors of over 44,000 to these on-line resources.
- **Special Events and Festivals** – These are open to the general public and are used as a means to inspire the population to get involved with science and theoretical physics. In 2009, PI held a Quantum to Cosmos: Ideas for the Future Festival in Waterloo that attracted over 40,000 in person visitors and one million on-line and TV viewers.

PI has effectively leveraged on-line resources to broaden their reach. They have not only provided a record of events, festivals, and lectures on-line to make their content more accessible to people globally but have also posted their outreach materials, such as Alice and Bob and I Love Science, on other sites, such as You Tube, to expose the information to individuals interested in science who would not necessarily be aware of PI. This has consistently resulted in more page views for its products, with the exposure from I Love Science increasing from 3,000 page views on PI's website to 21,000 on other sites. Given the impact of this avenue, we encourage PI to expand the number of on-line products that are made available through other sites.

In making the determination of whether or not to make changes to improve an outreach product or whether to produce similar products, PI specifically considers the estimated cost and impacts through planning exercises for all significant and material products and programs.

***We found that PI has implemented formal mechanisms through which feedback on the effectiveness of outreach activities is obtained and responded to on a timely basis.***

For key elements of its outreach program, PI has implemented formal feedback mechanisms through which the feedback of targeted stakeholder groups is obtained. The primary mechanism utilized by PI to obtain feedback on outreach activities is participant surveys. Based on our examination of surveys conducted over the past two years for the EinsteinPlus workshops and ISSYP programs, we confirmed that PI obtains and summarizes the results of participant feedback for both the content of its programs and the quality of facilitators. We further observed evidence supporting PI's analysis of survey responses and feedback and their implementation of action plans to address key recommendations for improvement such as through changes to the subsequent year's programming.

Based on our review of a sample of feedback obtained by PI from various sources, including governments, students, teachers, and universities, stakeholders have consistently recognized the value of PI's outreach in playing a significant role in increasing the level of interest, awareness and understanding of science by students, supporting and enhancing the effectiveness of teachers across the country, and in making a direct impact in increasing the level of interest and awareness among the general public.