

REPORT OF THE APS TASK FORCE FOR INDUSTRIAL PHYSICISTS (final 08/26/06)

1. Introduction

The world has changed profoundly during the past 20 years (1). The Cold War has morphed into a War on Terror. A set of loosely coupled national economies has evolved into a highly interconnected and tightly coupled global economy based on a worldwide digital information network—the Internet (1,2). The creation of economic value from research knowledge has moved from the province of vertically integrated firms to loose global consortia (2,3). Research projects and their funding have gone global, with contributors from all over the world working together via the Internet (1,2). Trained technical manpower has become globally available and plentiful, as has the capital for commercially oriented R&D projects (2).

These changes have exerted a powerful influence on physics and physicists. An increasing percentage of physics PhDs are employed by industry: Up from 36% in the 1950s to 56% in the 1990s (4). In the global economy, the value of R&D, including physics R&D, is increasingly measured in terms of the economic value resulting from that R&D (1-3, 5). Moreover, this value is no longer being created primarily in large firms that sponsor central R&D organizations that perform basic research, like Bell Labs, GE, IBM, Dupont and Xerox in the past. Rather new models of creating value of R&D are being pioneered in which loosely-coupled, globally distributed organizations connected via the Internet constitute the new product development pipelines (2,3). In this new world industrial physicists no longer do basic research in the physical science in analogy with their academic cousins. Rather they perform applied research directly related to product development in a fashion that has historically been more associated with engineering than with science (6,7). Thus, their activities increasingly migrate away from the topics of interest to the American Physical Society (APS) to those sponsored by more applied oriented Physics Societies like OSA and AVS or sponsored by engineering societies (like the IEEE) and materials science oriented societies (like MRS or ACS).

Because of these changes, the role of industrial physicists in the APS has been declining. The percentage of APS members employed by industry has been dropping to its current value of about 20% (8). Industrial APS members rarely either publish in APS journals or attend its meetings (9). They receive a negligible share of APS prizes and awards, including Fellowship (8). Very few are active in APS governance (8). Approximately 70% belong to some other professional society in addition to APS (9). Most are connected to APS primarily via their use of *Physics Today* and *APS News* (9). Thus, at a time when the importance of physics to the nation is increasingly felt via its contributions to economic growth and prosperity, the role of the physicists who make these contributions in the APS has declined to the point of being almost invisible in the major APS activities.

Given this increasing gap between the need for a prominent physics profile in the global economy and the declining role of industrial physicists in the APS, the APS Executive

Board commissioned a Task Force for Industrial Physicists to assess the competitive situation of APS activities for industrial physicists and to make recommendations of how it can better serve this segment of its membership. The charge to the task force is presented in appendix A. The membership of the task force consisted of eight industrial physicists from a variety of firms. The roster is given in Appendix B. Several initial members dropped out during the study: A reminder of the low priority given APS activities by industrial physicists who are struggling daily just to perform their jobs in difficult environments. The task force held seven teleconferences commencing on January 26, 2006 and concluding on August 15, 2006. It performed an assessment of a partnership proposal by Fortnight Solutions for a web-based technical solutions service. It conducted an extensive survey of the competitive services and offerings of other scientific and technical societies serving industrial physicists. These results are reported in Appendix C. It prepared a questionnaire of the industrial members of APS and assisted in analyzing the results, which are reported in reference 9. Finally, based on the results of its studies, it proposed and refined recommendations pertaining to each item in the statement of task.

This document is the report of the Task Force for Industrial Physicists. In Section 2 the task force identifies the market segments that together comprise industrial physicists and gives a profile of those industrial physicists who are members of APS. Section 3 of this report addresses the first item in the charge to the task force: Improved Web services. Section 4 addresses the second item: Comparison of APS services to industrial physicists with those of other technical societies serving this audience. Because other societies serve important needs of this audience that APS does not, collaboration of APS with other societies to create enhanced relevant offerings and services is an essential step for APS to enhance its attractiveness to industrial physicists. Section 5 is devoted to the articulation of three specific, actionable recommendations to achieve this objective, in response to the third and final item in the statement of task,

2. Who are “Industrial Physicists” and What do They Use from APS

The APS survey of industrial physicists in the APS (9) reveals that they are divided into two main segments. The one familiar to APS and well served by it consists of physicists with institutional IT access to the literature (e.g., those in large & medium size firms as well as those in essentially all universities and government research laboratories). This access is purchased by the institutions with which they are associated and typically is provided to individual physicists without additional charge. These are the hard copy journal subscriptions and electronic information products (e.g., web access to journal archives) that currently are offered by APS and other American Institute of Physics (AIP) member societies.

There is, however, another sizable segment consisting of industrial physicists without institutional IT access to the literature (e.g., those in small firms, consultants, retirees). These individuals currently do not have access to the physics literature except by bootlegging such access as adjunct or other temporary faculty at an academic institution. They constitute, therefore, essentially a new market for APS and AIP technical

information products offered over the web with pricing appropriate for individuals with modest usage requirements. Offering products and services to this market segment is one of the major opportunities for expansion of the electronic information products and services market by the APS and other AIP member societies.

This survey also reveals other important characteristics of industrial physicists who are members of APS. They

- are web-email-telephone oriented;
- use physics on the job;
- need physics information far beyond APS journals;
- usually belong to other professional societies as well as APS;
- rarely publish in APS journals or attend APS meetings;
- use APS journals once a year or less;
- are connected with APS primarily via *Physics Today*, *APS News*.

Therefore the survey presents a picture of industrial physicist members of APS who are at best loosely coupled to the APS and who desire and need a variety of information services that APS does not offer but that competitive societies like the IEEE are attempting to offer. The task force suspects that this is not a stable situation, and in subsequent sections offers a variety of recommendations to better serve and hence stabilize this segment of APS members (i.e., current customers).

3. APS Web Services Evaluation and Recommendations

After extensive review of the results from the Industrial Physicists Survey (9), the members of the Task Force generated a list of potential services that would be most useful to industrial physicists (10). After prioritizing the list, the task force unanimously agreed that in their collective opinion the most useful service that APS could offer to its industrial physicist members is a physics analog to “myspace.com”, i.e., an on-line network of practicing physicists.

Recommendation #1: The APS should establish and maintain a searchable, online network, similar to “myspace.com.” This online service would facilitate interactions and networking among industrial physicists and would contain a list of expertise.

The task force realized that it did not have the expertise to pursue this recommendation. Further, it recognized that while APS has the technical and financial capability of constructing a web site capable of hosting such a service, the definition and oversight of this service must be done by competent and highly motivated volunteer members of APS. This is a massive task the success of which requires aggressive volunteer leadership. In an effort to identify an individual who might lead the implementation of this service, Mohsen Yeganeh contacted the FIAP Executive Committee and CCPD (Committee on Careers and Professional Development), as well as several FIAP members who have shown interest in serving industrial physicists. Professor Shadi Shahedipour-Sandvik (SUNY Albany), a close friend of FIAP, agreed to take the lead in assessing the feasibility such a service and pursuing its implementation. Professor Shahedipour-Sandvik can be contacted at: SShahedipour@uamail.albany.edu. *The task force*

recommends that the APS create an internal working team to assess the feasibility of creating such a service and contact Prof. Shahedipour-Sandvik to explore this topic.

Recommendation #2: Improve the on-line search engine for APS meetings — Bulletin of the American Physical Society (BAPS)

The online search engine <http://www.aps.org/meet/archives/index.html> for specific APS meetings (current meetings and archives) mostly serves those in the APS community who attend APS meetings. There are author, chair, and session indices, an epitome (schedule of sessions), and a list of invited speakers. The web site allows a simple word search of titles, abstracts, and institutions. The main purpose of this search engine is to help attendees plan their schedule at the meeting. Complex searches of the archives across multiple meetings are not possible. The database also seems to contain errors (for example, S. Zollner is listed as a coauthor of paper D15.00012 at the 2006 March meeting, yet he does not appear in the author index for the meeting).

For industrial physicists who often cannot attend APS meetings (7), it would be helpful to improve the BAPS search engine with the following goals: (a) Find experts in a certain field of physics who can be consulted about a problem. (b) Find students with certain skills for job openings. (c) Restrict the search to a geographic region to allow face-to-face interaction with experts without having to travel.

For all users complex searches (similar to Scitation or INSPEC) of the BAPS database should be enabled. The search engine should allow searching of the archives of all current and past meetings on line (back to 1993) with at least the following fields: author, title, abstract body, sorting category, institution, state, country, range of years, category of meeting (March, April, Section), etc. The APS should monitor the uptime of their search engine and aim for high percentage of uptime.

Recommendation #3: Implement a robust search engine for the entire physics literature suitable for use not only by academic and large commercial users but also by individual physicists working as consultants or at small firms.

The AIP product known as *Scitation* was singled out for examination as a potential example of such a search engine that already exists and could readily be made available to APS members. *Scitation* was selected because its publications contain forward links to other articles on the same platform. Forward links are links to articles that were published after a particular article that cite it. In addition, links between articles and editorially related material (for example, articles and errata, or comments and replies) are a platform standard. Links are also available to any author-supplied supplementary material (including multimedia) hosted on the *Scitation* platform.

A full description of what capabilities and services are offered using *Scitation* can be found at this link:

<http://scitation.aip.org/servlet/HelpSystem?KEY=SCI&TYPE=HELP/FAQ - ques1>

Scitation is a search engine, publicly available, that searches the literature currently generated by AIP and member societies (and in some case their historical archives) as well as certain other physics literature. Abstracts of the articles found are available free of charge. Since *Scitation* itself is not a subscription-based service, however, access to the journal articles published through AIP requires subscriptions from each member society. Thus, both the cost of subscriptions and the burdens of multiple accounts are on-line obstacles that inhibit many "non-academic", especially industrial, physicists from using these helpful resources. Nevertheless, as a search engine alone, *Scitation* is an attractive tool for industrial physicists, although perhaps less so to academic physicists who have access to other tools through their institutions. ***The task force recommends that the availability of this tool be publicized widely to APS members.***

The ultimate service that the task force envisages is the combination of this search engine with the availability of journal article packs (delivered via the web) across all AIP and member society journals. In order to examine the feasibility of such an offering, task force members volunteered to test a prototype of the offering under the guidance of Jerry Hobbs. Support and approvals from each Executive Director was given for a limited trial of such a pan-AIP journal subscription. Task force members were assigned user names and single passwords by the AIP On-Line Services staff. The trial period runs from mid-July through the end of September 2006.

Although the survey results of the *Scitation* search-engine and article-delivery trial are not yet available, it is generally considered a viable option that could easily meet the requirements of individual industrial physicists. Jerry Hobbs will make available a subsequent report on the findings of this trial to the APS Executive Board and AIP member society executive directors later in the autumn of 2006.

The most difficult barrier to overcome prior to offering such service to individuals will be parsing revenues for the provision of the articles equitably among the member societies to compensate them for their provision of access to their journal databases. The APS could be a leader in motivating AIP member societies to work through this barrier via a series of test offerings trying out various pricing and revenue sharing algorithms. This is the topic of recommendation #8.

4. Comparison of APS services to Industrial Physicists with Those of other Professional Societies

The task force conducted an extensive survey of the industrial membership of other scientific and technical societies serving industrial physicists, and of the services offered to this segment of their membership. Information was collected on six other societies, American Chemical Society (ACS), Electro-chemical Society (ECS), American Vacuum Society (AVS), Institute of Electrical and Electronics Engineers (IEEE), Optical Society of America (OSA), and Materials research Society (MRS). This was done by examining the websites of the societies as well as interviewing individuals knowledgeable in the society, usually a staff member in the member department, or equivalent. The results are presented in appendix C.

Of the six societies, three have intensive industrial membership representation: ACS, IEEE and OSA. The ACS and OSA have greater than 50% industrial membership. While the IEEE provided no data, it does have a significant industrial focus. One common feature of the three industrial-led societies that they represent a well-defined business arena: chemical, pharmaceutical and petroleum industries (ACS), electrical and computer sciences (IEEE), and optical research and communication (OSA). The APS represents physics broadly rather than being focused on a particular business arena. This fact leads to the notion of the “hidden physicist” in industry because physicists are likely classified as engineers or technologists in the workplace.

The results presented in Appendix C reveal that APS has one of the smaller proportions of industrial physics members (20%) of all the societies surveyed. Moreover, it significantly lags leading societies like IEEE in (a) providing easy (web) access to pertinent literature (b) including industrial physicists in society governance and awards, and (c) running meetings of interest to industrial physicists. Given the small percentage of APS industrial members these findings are not surprising.

Nevertheless, the “bottom line” of this survey is that APS lags other scientific and technical societies serving industrial physicists in providing to them benefits that they have indicated that they want (9) and that other societies provide in some form or another (Appendix C).

Recommendation #4: Greatly improve APS recognition and awards for industrial physicists.

The paucity of professional recognition offered to industrial physicists by the APS has been the subject of anecdotal complaints for many years, especially the lack of industrial physicist Fellows. ***The task force recommends that this issue be addressed, any systematic shortfalls documented, and remedies put in place.*** APS should determine if an appropriate percentage of prizes and awards are given to APS members in industry. (Only one of 51 recipients in 2006 was from industry.) A similar determination should be made for elevation to Fellowship.

The task force suspects, but did not have access to the data to demonstrate, that industrial physicists receive far less than their proportional share of Fellowship, prizes and awards. If this turns out to be the case, steps should be taken to improve this share, for example by recognizing physicists (a) who have become successful outside of physics, (b) who have had an impact on society with a patent or product, or (c) have excelled in leadership or management of a company or other private institution. Mechanisms should be sought to improve recognition of industrial physicists similar to other underrepresented groups, such as women and minorities. For example, additional Fellowship slots could be awarded to FIAP with rules that the FIAP Fellowship committee and FIAP’s Fellowship nominees need to contain a certain percentage of industrial APS members. Important APS fellowship and awards committees (such as Fellowship Committee or Committees on Prizes and Awards) should include members to represent the interests of industrial physicists. Among the 29 APS prizes and 15 awards, very few are currently awarded to industrial physicists, who usually work in product development, not fundamental or applied research. The APS Pake Prize recognizes a physicist who has made contributions in both research and management or leadership, but there is no prize for an industrial physicist who meets only one of the criteria. Nominations for such recognition could

come from APS members at academic institutions who seek to recognize their alumni. This issue is not unique to the APS among the societies surveyed. Nevertheless, it has been a continuing source of frustration and dissatisfaction of APS industrial members for at least the past decade, and deserves to be addressed in a forthright fashion.

During the course of its deliberations, the task force became aware of certain subtleties in implementing this recommendation, which are worthy of being called to the attention of the APS leadership. These result from the fundamentally different value systems of academic and industrial research. Academic (and most government) research is valued primarily on the basis of its effect on the community as reflected in publications, citations, invited papers at conferences and the like. Industrial research, on the contrary, is valued primarily on the basis of its impact on the commercialization of a new product or service. Publications and conference presentations are at best secondary, and often are explicitly discouraged in order to protect the intellectual property resulting from the work. To reward outstanding industrial physics research, prize, award and fellowship committees must be comprised of individuals that understand the industrial research value system and can evaluate candidates accordingly.

The subtleties arise from the fact that the differences between the value systems also create a situation in which APS fellowship and awards committees, which are appointed at the unit level, are comprised predominately if not exclusively of physicists employed at academic and government institutions. FIAP affords an illuminating example of this dynamic in action. While its original leadership was almost exclusively industrial physicists, over time it has come to be increasingly dominated by academic or government physicists who, naturally, apply their own value system in selecting Fellows, prize and award winners. This has occurred because APS members attracted to FIAP have been primarily applied physicists from these environments who get rewarded for their participation in FIAP activities like invited paper sessions at APS meetings or FIAP governance functions. Industrial physicists do not get similarly rewarded, so they are less motivated to participate. This fact was reflected in the industrial membership survey (9) by the observation from the write-in comments that many if not most of the members surveyed were unaware of FIAP or its activities. This was much less of an issue fifteen years ago when large firms like AT&T, IBM, GE, Dupont, Dow, GM, Ford, Xerox and the like sponsored large central research laboratories one component of which was the pursuit of basic research in physics. The physicists in these firms who performed such research were rewarded for their participation in APS affairs and were well represented on APS unit governance. As noted earlier, however, in the new global economy these institutions have disappeared and with them the pool of APS industrial physicist members who actively participate in its meetings and publications. *Therefore the task force recommends that special efforts be made to secure more active participation of its industrial physics members in APS unit governance, especially prize and award committees, if the APS wishes to encourage this class of membership.*

Recommendation #5: The APS should sponsor a prize for the industrial applications of physics in the biannual years that the AIP Prize for the Industrial Applications of Physics is not offered.

The AIP currently offers a biannual prize to recognize outstanding contributions by an individual or team to the industrial applications of physics. This is the only physics prize given exclusively for industrial applications of physics. In recent years there have been ample nominations for this prize to support the annual award of such a prize. Moreover, if a new prize were offered in the intervening biannual years, special conditions could be placed on this new offering, e.g., to individuals or teams from small firms. Thus, the combination of funding for an additional prize for the industrial applications of physics coupled with some special restrictions to target underrepresented industrial physicists in the APS is a simple, actionable proposal to double immediately the prizes offered for the industrial applications of physics as well as introduce a new APS prize for such contributions.

5. Exploration of Potential Partnerships

One of the major findings of the APS survey of its industrial members is that these individuals use a large cross section of the technical physics literature that far transcends the scope of APS journals. The literature that they wish to access via search engines and use via simple, convenient web access is the entire panoply of AIP and member society journals, together with as much of the additional physics literature as possible. Thus, the task force suggests that the greatest service that APS and other AIP member societies can offer to individual industrial physicists who are their members is to come together and offer convenient web searches coupled with web-based journal article packs which encompass all AIP and member society journals. Moreover these offerings should be tailored to individual physicists who do not have access to large institutional library subscriptions. This would enable the small firms and consultants, the wellsprings of much of the innovation in the US, to access the physics literature on an even playing field with their better-funded (usually at taxpayer expense) brethren. It also offers AIP and member societies an opportunity to expand their offerings to include new products and services uniquely tailored to create new markets in the age of the global internet.

Recommendation #6: Expand APS journal article packs

Currently, APS article packs (copies of individual articles delivered over the web) are restricted to APS journals (*Physical Review* and *Physical Review Letters*) and limited to issues from the last three years. Twenty articles currently cost 50 dollars (very reasonable). A hardcopy printed from the downloaded PDF article and results of journal searches are for personal use only and may not be shown to others. This policy is not suitable for industrial physicists for three reasons: (a) Industrial physicists usually work in an interdisciplinary environment and need access to journals from a broad range of fields. (b) Quite often, it takes 10 or 20 years or even longer for a physics discovery to become relevant for industrial product development. Therefore, older papers are often more useful for industrial physicists than more recent ones. (c) Industrial physicists usually work in teams, not alone, usually with people from other fields who are not likely to APS article pack licensees. A printed hardcopy is useless, if it cannot be shown to coworkers.

Some changes to the current offering can be made immediately. First, the journal period for article packs should be expanded to include all on-line issues of APS journals (e.g., The Physical Review from its first issue over a hundred years ago, not just the last three years). Second, the terms of use should be at least as permissive as those for a purchased book. A subscriber should be allowed to print one copy of the downloaded PDF file and circulate it within his/her company as long as no copyright laws are broken (e.g., no additional copies to be made without payment of a royalty fee).

One of the primary findings of the survey of APS industrial members (9) is, however, that industrial physicists need access to all of the physics literature not just APS journals. Thus, the APS cannot meet their needs without cooperative arrangements with other creators and publishers of physics literature, especially the applied physics literature. This finding motivates recommendation #8, described below.

Recommendation #7: Create new classes of membership, attractive to industrial consultants and physicists employed at small firms, which bundle journal article packs with the membership fee.

While it may not be economically feasible to include free access to APS journals as a membership benefit, some scientific societies (e.g., AVS and MRS) offer some free online publication access to their members (see Appendix C). This access is especially valuable to APS members in industry and APS senior members, since students, professors, and government researchers usually have access to journals through their institutions, while other physicists usually do not have journal access. We suggest two alternative approaches to such new offerings.

Teaser memberships: The APS could include a small number of APS articles (a “teaser” article pack) free with membership. This would be a marketing tool with the intent that members would purchase additional articles if they find the first few articles useful. Many companies (internet service providers, cable TV companies, etc) offer a free month to recruit new customers. Why not give away a few free articles to generate more revenue?

Industrial physicist memberships: The task force recommends generating a new type of membership, which would initially include a ten-article pack (all APS journals, not limited to the last three years) with membership dues that are 25 dollars above the basic APS membership rate. As noted earlier, however, industrial physicist members of APS need and want access to all the physics literature, not just to APS journals. Thus, to be attractive to industrial physicist members of APS, the scope of the article pack in this new class of membership probably will need to be extended to other AIP and AIP member society journals. This is the topic of recommendation #8 below.

Recommendation #8: Work with other AIP member societies to create all-AIP-and-member-society journal packs for individual APS members and to allow AIP and member societies to create similar offerings to small firms as well as individual members.

This is a hugely important recommendation. From the perspective of the findings of our surveys, it is evident that APS and other industrial physicists are interested in journal packs that cover all the journals published by AIP and its member societies rather than those encompassing just the journals of a particular society. This recommendation basically suggests to the APS leadership that they do the obvious: Give the customers what they want. From a more strategic perspective, this class of physics information services will bring access to the physics literature to the people who are most likely to generate economic value from it, i.e., physicists and engineers employed by small firms. This is what the APS is all about: Disseminating the knowledge of physics to the folks that can use this knowledge to create products and services that serve mankind and generate economic prosperity. This is a high calling for the APS in the 21st century.

The attributes of these services are straightforward. For example, a new subscription class that "bundles" a pre-set number of articles could be created through cooperation among AIP member societies. If there were common views among AIP Member Society Executive Directors--they acknowledge the rapidly changing and specialized roles that prospective industrial members serve in the greater community--then they could cooperate to offer broad-based journal article packs that include articles from the journals of multiple AIP member societies as well as AIP itself. Our survey (9) reveals that physicists working in smaller and medium sized companies are requesting precisely this sort of web-based electronic technical information products.

A site-licensed "Industrial Class Journal Package" or bundle of 5 or 10 articles might be easily purchased through infrastructure set up by AIP Online Services. The validation could be set to access and download both current and historical entries. Further, the bundle could be given a "time stamp" that would expire within a brief period--say becoming invalid after six months from purchase.

Administrative time, capital and operating costs are required to create such bundled "Industrial Class Journal Packages". These and other issues would have to be discussed among member societies and AIP staff to reach agreement. As discussed in association with Recommendation #3, deciding how to parse out revenues among member societies whose journals are accessed through such AIP-delivered services is a delicate topic. The benefits to those individuals focused on industrial physics are, however, clear. Making broader ranges of subject areas and expertise readily available enables innovative ideas and the more rapid commercialization of new products and services based on physics research knowledge. The logistics of equitably sharing the income resulting from the industrial class journal packages is a significant problem that must be resolved.

There are external examples of bundled journals provided for a fee. INFOTRIEVE is a company that serves the needs of those who are working in small- and medium-sized companies. Like INFOTRIEVE, AIP could take the role of a physics information broker and provide PDF files of scientific articles to subscribers for a fee, collect the fees, and redistribute them among the AIP member societies or other entities owning the copyright to the downloaded PDF files. This would open the road to AIP-wide article packs that allow access to articles published by AIP and all AIP member societies (and perhaps even some societies outside of AIP through reciprocal relationships). The scope of this view transcends the APS so the task force does not offer it as a recommendation. But *the APS*

can take a leadership role within the AIP in making this happen, and we recommend that course of action.

6. Wrap-Up

During the past 20 years the world has changed profoundly requiring physics and physicists to do likewise. These changes are affecting the APS in three major ways. First, the creation of economic value from physics research and the industrial employment of physicists are increasingly becoming primary value propositions for physics to secure funding from the public purse. The shock troops that generate this value are industrial physicists. Thus, industrial applications of physics created by industrial physicists are becoming the primary currency to motivate incremental governmental investments in physics research and education. Second, the employment of PhD physicists is increasingly in industry as opposed to government and academia. Therefore the jobs for which the academic physics profession is supposed to prepare its graduates are changing in character relative to the decades of the 1950s through 1980s. Third, the relative competitive attractiveness of physics education and employment in the US is declining. Opportunities for physics research and education are increasing in both Europe and the Far East. Rapid technological growth is migrating away from the physical sciences into information technology and biotechnology. These trends all point to a future for physics and physicists, which is rather more challenging than the past: A future in which industrial applications of physics and industrial physicists are increasingly important to the health of the whole profession. Because of this the APS leadership is rightly concerned with supporting the activities of its members who are industrial physicists and with bringing their contributions to the attention of government funding agencies.

One particular aspect of this situation is the demise of the large corporate US R&D laboratories that performed basic research in physics. This, in turn, has deprived APS of a sizable pool of industrial physicist members whose research was quite similar to that of academic physicists and the value of whose work was judged on a similar basis (e.g., impact on the community as measured by publications, conference presentations, invited papers etc.). The remaining industrial physicists in APS are increasingly employees of small firms and consultants, the value of whose work is judged primarily on the basis of its impact on the value of commercial products and the speed of commercialization. Moreover, these industrial physicists typically do not have access to institutional subscriptions to APS and other physics technical journals. This is a distinct community of APS members, quite unlike the traditional industrial physicist community drawn from large industrial R&D organizations. As noted above, this fact complicates the serving of this community by APS because traditional APS offerings like journal subscriptions and meetings are not widely used by this class of industrial physicists.

The APS leadership commissioned this Task Force for Industrial Physicists that has done its job of collecting data to define the needs of APS industrial physicists, comparing current APS offerings in this arena with those of other professional societies serving this market, and providing specific recommendations for new APS offerings that will enhance the value of APS membership and offerings to its industrial members. The task force has tried mightily to offer simple and actionable recommendations. One of its major findings

is that industrial physicists want and need convenient and inexpensive access to a broader swath of the physics literature than that generated in APS journals. ***The APS can make its greatest contributions to the creation of economic value via the diffusion of the knowledge of physics in the networked 21st century through collective action with other physics societies to offer physics information products and services that span all of physics and that are conveniently available over the web at low cost. Moreover, it can take a leadership role in creating and offering such products and services within the AIP framework.*** The task force encourages the APS leadership to place a top priority on achieving these objectives.

7. References

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Appendix A: Charge to the APS Task Force for Industrial Physicists

The nature of industrial physics has undergone significant changes in the last decade and the Task Force for Industrial Physicists will work to enable the APS to expand and improve its services to this large and important segment of the physics population. The task force will report to council on the following activities:

1. Collaboration with staff and consultants in modernizing the APS web site, for example, by identifying and evaluating web-based connectivity and networking tools which facilitate participation of all APS members.
2. Investigation of the programs and services AIP member societies and other societies such as the MRS, ACS, and IEEE offer to industrial members.
3. Exploration of potential partnerships with other societies to jointly leverage these offerings for the benefit of APS members.

Appendix B: Roster of Task Force for Industrial Physicists

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Appendix C: Services offered to Industrial Physicists by Professional Societies

Society	Industrial Membership	Total Membership	Free subscriptions with membership	Other Benefits	Website
American Physical Society	20%	45000	<i>Physics Today</i> , <i>APS News</i>	Membership directory, Insurance, discounts, AIP services	Phys. Rev Focus, Career Center,
American Chemical Society	60%	150000	<i>Chemical & Engineering News</i> (online and print versions) and <i>Chemistry</i> online member-magazine	Insurance program, Mortgage financing, Credit card, Consumer line of credit, CD, Auto rental discount (Hertz, Budget, Avis, Hotel discount, Moding assistance, and Travel programs	extensive chemistry website, with publications and research resources in addition to ACS-specific information.
Electro-Chemical Society	34%	7784	Access to ECS Digital Library	Meetings, membership directory, some discounts.	Launched the new web site and the digital library
American Vacuum Society	42%	4000	Subscription to <i>JVS&T A</i> and <i>B</i> ; <i>Physics Today</i>	Group insurance, Hotel discount, AIP services, AVS quaterly, "networking opportunities", Career networking service, Membership in up to 2 local AVS chapters	Buyer's guide and reference guide, Membership directory
IEEE	N/A ¹	360000 ²	<i>IEEE spectrum</i>	Access to technical publication are a big draw for members Insurance, proceedings of the IEEE, home and office supplies(?), travel	Access to IEEE xplore, Careers.ieee.org
Optical Society of America	53% ³	>14000, 64% within the US	<i>JOSA A</i> , <i>JOSA B</i> , <i>Optics letters</i> or the <i>Journal of Optical Networking</i> free of charge, or you may select <i>Applied Optics</i> for a discount, + <i>Physics Today</i>	OSA's research indicates that journal and networking is considered a significant benefit. Beta-testing new on-line networking.	www.workinoptics.com is an extremely popular website for people looking for jobs in optics with the majority of posting from companies. Rolling out new website in the fall
Materials Research Society	21%	13500	<i>MRS bulletin</i> (free) Discounted MRS proceeding and JMR	"MRS alerts", Membership directory	Three level of website access: open, registered user, and member; "Material connection" and "Career central" available on the web

- Note
1. IEEE does not classify members by occupation, but by technical interest
 2. World-wide
 3. OSA defines non-academic as individuals not working at colleges, university and institutes.
 4. Data provided from on-line sources and conversation with
 - Gail Oare, MRS
 - Beth Hampton, Alison Reznick, OSA
 - Director of membership at ACS
 - Felicia Taylor, IEEE
 - Yvonne R. Towse, Administrative Director, AVS
 - Heidi Rixman, Director of Membership and Development, ECS