NATIONAL PROGRAM FOR RESEARCH CENTERS OF EXCELLENCE (FONDAP)

FINAL EVALUATION REPORT

This form is intended to facilitate your work as a referee and standardize the evaluation reports. Each topic is expected to be evaluated with concepts ranging from outstanding to poor and detailed technical comments supporting your points on the report.

If the Center report does not contain information on the given topic, please indicate so in your evaluation.

Your final overall comments and recommendations are an important part of the review process.

I. PROJECT INFORMATION
CENTER'S NAME: CIMAT
DIRECTOR: FERNANDO LUND

II. EVALUATION PANEL			
REFEREE NAME	**ORGANIZATION/ INSTITUTION**	**E - MAIL**	**SIGNATURE**
REVIEWER 1			
REVIEWER 2			
REVIEWER 3			

III. CENTER ACHIEVEMENTS

1.- Scientific achievements and their impacts to local, national and international community.

i.- Comments

CIMAT has placed Chile on the world materials research map. Over a decade it has built upon the pre-existing excellence of a handful of individuals and broadened their work into substantial new fields, creating highly productive groups in each area.

The Center's publication list is highly impressive in both its quantity and quality, with almost five hundred publications in refereed journals, including several in Science and Nature journals. This is highly competitive for a Center of this size anywhere in the world.

The evolution of the Center's research has led to major breakthroughs, establishing internationally competitive, even leading, research groups in several areas. Particularly, the Mechanics of Complex Materials / Materials Far from Equilibrium group is recognized as among the handful of leading groups worldwide in this field. This level of achievement and recognition can be directly attributed to CIMAT. The Polymeric and Catalytic Materials group has demonstrated international competitiveness, and brings the entire Center great credibility in the engineering, technological and industrial realms. The bio-mineralization work is also internationally competitive, and while this group initially had a rather limited publication record under CIMAT support, they have responded very effectively in increasing this publication rate in recent years. They have also contributed greatly to the intellectual breadth of the Center, successfully integrating physical and biological sciences. The earlier effort in New Magnetic Materials also contributed substantially to the publication and education success of the Center.

The Center's research, while primarily focused on advancing fundamental understanding of important materials phenomena, has also demonstrated substantial technological potential. The work on granular materials and wrinkling is already being assessed for potential impact in the mining and food packaging industries, respectively. The Polymeric and Catalytic Materials group has several patents pending, with one granted and one licensed.

CIMAT has elevated the reputations and infrastructure of the participating departments and institutions, enhanced the scientific enterprise across Chile and Latin America, and interacted broadly with the international community.

ii.- Evaluation

Outstanding	Very Good	Good	Poor
X			

2.- Educational achievements and impact. Pay attention to integration of research and educational activities, and also in training advanced human resources, participation in PhD Programs.

i.- Comments

CIMAT's efforts in the integration of research and education and the development of science and engineering human resources have been comprehensive, from the undergraduate to the associate investigator level, and have had large and qualitatively substantive impact in Chile and abroad.

Over a 10-year period CIMAT investigators have supervised about 90 undergraduate research theses, over 35 master theses and about 60 PhD theses, many of them in interdisciplinary areas that cross traditional departmental boundaries. PhD graduates have gone on to postdoctoral or faculty positions at universities in Chile, other countries in Latin America, the US and Japan, as well as industrial positions in Chile, Brazil and Germany. CIMAT also supported and trained about 20 postdoctoral research associates who have subsequently taken faculty positions in Chile, Canada, Mexico and France, among other positions. Not only was the Center successful in its placement of recent PhD graduates and post-doctoral associates, but the CIMAT umbrella allowed for the broad advertisement of postdoctoral openings and effective recruitment of postdoctoral associates for the Center in a global scale.

Through the efforts of CIMAT's participants, a waning PhD program in materials sciences was revitalized through a major grant to establish a network of materials-related PhD programs in Chile, which included funds for the acquisition of major research equipment (e.g. a high resolution transmission electron microscope).

At the undergraduate level, CIMAT participants developed and implemented a novel undergraduate research internship program open to all students on a competitive basis. About 80 interns have participated in this program through its five years of operation. CIMAT participants also reformulated undergraduate materials-related programs at U. de Santiago de Chile that included new laboratory capabilities acquired through a major grant.

CIMAT chose to allocate additional funds provided by FONDAP to an open competition of research projects from its associate investigators. This is a testimony of the Center's commitment to professional development at all levels.

It is laudable that all Center participants, particularly graduate students, were afforded extensive opportunities to travel internationally for research collaborations and conferences. This is a major impetus to their professional development. To further advance international interchange, we suggest that where possible, and consistent with the regulations of the host universities, PhD theses should be encouraged to be written in English.

ii.- Evaluation

[X]	[ ]	[ ]	[ ]
Outstanding	Very Good	Good	Poor

3.- National and international collaboration achievements. Pay attention to activities that contributed to national and international networking.

i.- Comments

CIMAT's multi-pronged efforts in the international networking area have been highly effective and have resulted in international recognition of the Center in the materials research area. International networking efforts include:

- organization of a series of international workshops (4) on 'Frontiers in Materials Research'
- organization of a series of 'Southern Workshops in Granular Materials' (3)
- co-organization of international meetings in crystallography, copper, biomineralization, electron microscopy and chemical reactivity
- co-organization of the 2009 International Congress in Ultrasonics and of a symposium at the International Conference in Advanced Materials (ICAM)
- extensive participation of CIMAT participants, including graduate students, in international workshops, conferences, and research visits
- hosting of over 300 international researchers, including over 60 students

In addition to the above traditional approaches to international linkages, CIMAT implemented highly creative approaches to enhance its international presence:

- the availability of CIMAT's unique single-crystal X-ray diffractometer to researchers from other countries enabled the development of research collaborations with investigators in Argentina, France, and India
- highly effective interactions between CIMAT researchers and international members of the Center's Advisory Committee (AC). These encompassed development of interactions with other investigators at the universities of the AC members. This in turn facilitated the establishment of new international activities such as the student exchange program between the mechanics of complex materials group at CIMAT and a similar research group at the University of Chicago (co-sponsored by CONICYT and the US National Science Foundation), and the CIMAT-UC Santa Barbara undergraduate exchange program.
- the outreach to international industrial associations, such as the International Copper Association and the International Molybdenum Association, through research and development initiatives implemented/managed by CIMAT in areas of interest to these associations further enhance the Center's international recognition.

ii.- Evaluation

X			
Outstanding	Very Good	Good	Poor

4.- Outreach Achievements. Pay special attention to those activities that tied the Center with the external community such as elementary or high schools, institutions, companies, among others.

i.- Comments

CIMAT has made many substantial contributions to outreach in several directions. CIMAT researchers have engaged in multiple activities with pre-university students and the general public. These have included participation in the EXPLORA program, development of four interactive programs (visited to date by more than 150,000 people) that communicate CIMAT-related scientific concepts to the general public and involvement in a program called "The Universe of the Light" at the U. Santiago Planetarium. They have also delivered talks to multiple trade and industrial institutions, such as those representing the electronic and electrical, poultry and salmon industries. These efforts have been very good, but they would have been stronger and more effective if all personnel affiliated with CIMAT had more fully participated.

In particular, the CIMAT leadership has worked very hard to establish major partnerships with the mining industry in Chile, particularly with respect to exploring new applications for copper and molybdenum. It has spear-headed the development of new joint ventures between mining companies and U. Chile, including the formation of COMOTECH to explore new technologies utilizing molybdenum, and the Consortium Project Copper for Energy. CIMAT's role in these partnerships is to provide appropriate research and development test beds. CIMAT has also teamed with the International Copper Association to organize global calls for research proposals to identify new technological markets for copper.

CIMAT has also attempted to be directly relevant to the Chilean mining industry by embarking on research projects exploring new applications for and properties of copper-related materials. In previous reviews, members of this review committee have been concerned that this has potentially distracted the Center from its primary research goals, and not enhanced the quality of its research. The Center leadership has responded positively to our previous comments and has now focused Cu-related research in a limited number of activities that better complement CIMAT's core research fields. It is important that this balance be maintained in future FONDAP Centers. The Center's work on granular materials also has much potential relevance to the mining industry, as does its work on the science of wrinkling to the food packaging industry. Another major industrial alliance is with the Brazilian petrochemical company, Braskem, focusing on industrial scale-up of materials technologies developed in the Polymeric and Catalytic Materials group.

Through supplemental CONICYT funding, the Center has founded a Business Unit to help align the Center's research advances with the technological requirements of Chile's commercial sector. This Unit has been instrumental in developing the strategic partnerships described above.

Another excellent example of outreach is the outstanding brochure the Center assembled at the end of the ten year period. This will serve as an enduring testament to the Center's achievements.

ii.- Evaluation

☐	X	☐	☐
Outstanding	Very Good	Good	Poor

IV. OTHER RELEVANT ASPECTS

If the Center report does not contain information on other relevant aspects, please indicate so in your evaluation.

i.- Comments

Center Management

CIMAT's leadership has internally managed the Center activities in an effective and collegial manner. The research program was reconfigured through the years following recommendations of the Advisory Committee and of external evaluators. Difficult decisions were made to terminate research lines that either were not as successful as anticipated (ceramic films and interfaces) or that did not contribute as much as anticipated to the integrated efforts of the Center (magnetic/inorganic materials). Also in response to external advice, ongoing research lines were modified, such as the integration of theoretical and experimental efforts in the mechanics of complex materials area. At the same time, CIMAT leadership provided appropriate recognition and support to efforts that were relevant to the success of CIMAT yet were not a separate research line, such as the crystallography laboratory. In support of the professional development of more junior investigators within CIMAT, two Associate Investigators were promoted to co-Principal Investigators.

CIMAT organized yearly 'all hands 'meetings where scientific aspects of the Center were discussed. Discussions of general organizational and strategic matters relevant to the Center operation including all participants might have further helped to integrate junior researchers and students into CIMAT's mission.

The commitment of CIMAT's leadership to the professional development of junior researchers was demonstrated in the competitive allocation of supplemental FONDAP funds to research sub-projects from associate investigators. This practice gives additional Center 'ownership' to associate investigators and should be encouraged at all FONDAP centers.

V. CENTER PROJECTIONS

Please comment about the center projections after the 10 -year FONDAP grant. If the Center report does not contain information on the Center projections, please indicate so in your evaluation.

i.- Comments

With CIMAT not re-competing in the current FONDAP competition, it is critical that the outstanding momentum that it has provided for materials research in Chile not be lost. This applies not only to the Center's research activities, but also to the academic programs that were strengthened through the CIMAT organization. Maintaining the collaborative research efforts that achieved extensive international recognition through CIMAT's stewardship should be one priority. Maintaining the extensive opportunities for undergraduate research opportunities in materials research that CIMAT afforded should be a second. Ensuring continued progress in the development of materials science and engineering as a well-populated PhD degree option nationally should be a third. Ensuring continued progress the in development of materials science and engineering as a well-populated PhD degree option nationally should be a third. Finally, the major facilities that were established directly or indirectly through the CIMAT program must be maintained, and continue to be accessible to all qualified researchers in Chile. In particular CIMAT has taken primary responsibility for the acquisition, staffing and maintenance of the single crystal X-ray diffraction facility at U. Chile. This is a national resource and alternative plans for its continued support and operation should be implemented immediately. Similarly, a plan should be implemented for the long term support of the high resolution transmission electron microscope at U. Chile. While this was not directly acquired and maintained by CIMAT, the Center's researchers represent the core constituency for its application to advancing materials research in Chile. Given the major level of investment in this instrument, its continued operation and accessibility to all qualified researchers (especially for hands on operation by students and postdocs) in Chile should be a key priority. Furthermore, as Chile continues to invest in major instrumentation, firm financial and operational plans and mechanisms for long term maintenance of this equipment must go hand-in-hand with major equipment awards.

VI. INSTITUTIONAL COMMITMENTS

Please comment about the facilities available to the Center, the commitment of the administration of the leading and partner institutions to the Center, and the commitment of the partner institutions to achieve the Center goals.

i.- Comments

The main participating institutions, U. de Chile (UCH) and U. de Santiago de Chile (USACH), appear to have fulfilled their commitments in terms of cash contributions and new faculty hires. Most faculty hires took place during the second 5-year grant period. It would have been useful to have a clear delineation of faculty hires that were made in specific response to perceived expertise needs at the Center.

While the participating institutions have fulfilled their stated commitment to the Center award granted by CONICYT, it is not clear what the their current commitment is to the sustainability of the human and physical infrastructure developed at the universities during the last ten years now that the grant is coming to an end.

ii.- Evaluation

	X		
Outstanding	Very Good	Good	Poor

VI. ADVISORY COMMITTEE

Please comment about the commitment of the advisory committee, and its contribution to the Center development.

i.- Comments

The Advisory Committee has been a great asset to CIMAT. While it has inevitably changed in membership over ten years, it has consistently comprised a strong team of international leaders in materials research, with members predominantly from USA, Chile, Europe and Asia. Its members have been dedicated and have provided excellent advice. The committee met most years in Chile, and produced substantial, insightful and helpful reports. Members of the Advisory Committee have also served as excellent conduits to the international materials community, and this has led to several substantial international collaborative programs, for example with UC Santa Barbara and U. Chicago.

ii.- Evaluation

X			
Outstanding	Very Good	Good	Poor

VI. FINAL OVERALL COMMENTS AND RECOMMENDATIONS

Please provide a final overall and recommendations for the Center. Include here aspects that were not covered in the previous sections, which you consider significant for the Center.

i.- Comments

As testified by its publication record, the growing international reputation of its research groups, and its recognized leadership in several fields, CIMAT has made a remarkable impact in establishing the broad field of materials research in Chile. Similarly in its educational programs, it has elevated the visibility of materials research among undergraduate, graduate and postdoctoral students and researchers, providing leading edge opportunities for all of these populations. It also achieved an excellent balance of basic and applied research, and theory and experiment. Finally, it has been instrumental in developing a new generation of leaders in the field of materials research in Chile. These are achievements that are of lasting benefit to the science and engineering enterprise in Chile.

Of paramount importance is that this momentum be maintained. CIMAT has placed Chile on the world map in materials research, and the foundations have been laid for establishing Chilean Materials Science and Engineering as a world class discipline. It is critical that ongoing commitments to MSE PhD programs and curricula development are maintained. Equally, major facilities directly or indirectly established through CIMAT must be maintained. Another major role that CIMAT played was as a coordination point for materials research across Chile. Alternative mechanisms (e.g. a Chilean branch of the Materials Research Society) should be implemented. Finally, we propose that a national level planning exercise be initiated to plan the further growth of materials research and education in Chile, to capitalize on the achievements of the CIMAT program.

ii.- Evaluation

X			
Outstanding	Very Good	Good	Poor