

# **SANDIA REPORT**

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## **International Initiative to Engage Iraq's Science and Technology Community: Report on the Priorities of the Iraqi Science and Technology Community**

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## **Abstract**

This report describes the findings of the effort initiated by the Arab Science and Technology Foundation and the Cooperative Monitoring Center at Sandia National Laboratories to identify, contact, and engage members of the Iraqi science and technology (S&T) community. The initiative is divided into three phases. The first phase, the survey of the Iraqi scientific community, shed light on the most significant current needs in the fields of science and technology in Iraq. Findings from the first phase will lay the groundwork for the second phase that includes the organization of a workshop to bring international support for the initiative, and simultaneously decides on an implementation mechanism. Phase three involves the execution of outcomes of the report as established in the workshop. During Phase 1 the survey team conducted a series of trips to Iraq during which they had contact with nearly 200 scientists from all sections of the country, representing all major Iraqi S&T specialties. As a result of these contacts, the survey team obtained over 450 project ideas from Iraqi researchers. These projects were revised and analyzed to identify priorities and crucial needs. After refinement, the result is approximately 170 project ideas that have been categorized according to their suitability for 1) developing joint research projects with international partners, 2) engaging Iraqi scientists in solving local problems, and 3) developing new business opportunities. They have also been ranked as to high, medium, or low priority.

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# Report on the Priorities of the Iraqi Science and Technology Community

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## Executive Summary

This report describes the findings of the effort initiated by the Arab Science and Technology Foundation (ASTF) and the Cooperative Monitoring Center (CMC) at Sandia National Laboratories (SNL) to identify, contact, and engage members of the Iraqi science and technology (S&T) community. The goals for the cooperative program include:

- Developing joint science and technology projects that engage Iraqi scientists in peaceful research and development activities;
- Engaging Iraqi experts to solve local problems; and
- Developing new Iraqi business opportunities that provide long-term sustainability to Iraqi S&T.

The initiative is divided into three phases. The first phase, the survey of the Iraqi scientific community, shed light on the most significant current needs in the fields of science and technology in Iraq. Findings from the first phase will lay the groundwork for the second phase that includes the organization of a workshop to bring international support for the initiative, and simultaneously decides on an implementation mechanism. Phase three involves the execution of outcomes of the report as established in the workshop.

ASTF, a non-governmental organization (NGO), is well placed to undertake initiatives that engage the Iraqi S&T community. ASTF conducted its work during Phase 1 through the participation of highly qualified team members with direct knowledge of Iraqi institutions and the people employed therein. Members of the ASTF team are employed in academic and research institutions of Arab countries, the United States, and Europe. They are people known for their integrity and good will towards their collective objective. Over the years, they have formed friendships in all walks of life in Iraq and their commitment to a prosperous and peaceful

Iraq is beyond doubt. During the survey, additional team members were recruited from Iraq. The Iraqi team members were from universities, former and current ministries, and private industry.

While other organizations are either working with the Iraqi S&T community or developing proposals to do so, the ASTF/CMC effort is unique due to the comprehensive nature of the survey effort and the inclusion of Iraqis in the survey process. Additionally, this project is not solely devoted to redirecting former WMD scientists, but intends to engage the entire S&T community. This survey effort is also the first to have generated a large number of project ideas that reflect the priorities of the Iraqi S&T community.

During Phase 1 the survey team conducted a series of trips to Iraq during which they had contact with nearly 200 scientists from all sections of the country, representing all major Iraqi S&T specialties. As a result of these contacts, the survey team obtained over 450 project ideas from Iraqi researchers. These projects were revised and analyzed to identify priorities and crucial needs. These findings were later subjected to open discussion in a workshop attended by a number of most distinguished community leaders and members. After refinement, the result is approximately 170 project ideas that have been categorized according to their suitability for 1) developing joint research projects with international partners, 2) engaging Iraqi scientists in solving local problems, and 3) developing new business opportunities. They have also been ranked as to high, medium, or low priority.

Project proposals were received in 12 S&T categories:

1. Health
2. Water Resources
3. Environment
4. Engineering
5. Energy
6. Agriculture
7. Veterinary and Livestock
8. Biotechnology and Genetics
9. Communications
10. Materials
11. Basic Sciences
12. Information Technology

Priorities were defined for each of the 12 subject-areas, but from the perspective of the needs of the Iraqi community, the highest priority areas were found to be health, water, the environment, housing, and electricity.

In addition to priorities for S&T, the survey team also emphasizes two general themes: 1) there is a generation gap between older and younger Iraqi scientists which should be bridged, and 2) Iraqi scientists will need help in adjusting to advancements of science that have occurred over the last two decades. Regarding the generation gap, older scientists were typically trained at internationally recognized institutions, whereas the younger generation has been trained almost exclusively within Iraq. The result is significant loss of expertise, including a marked scarcity of mathematicians. Information technology expertise is also largely absent. Bringing the Iraqi scientific community up to date will require a specific focus on the younger generation, as well as updating the older generation. In addition, outdated equipment and techniques will need to be replaced. Capacity building for scientific personnel is a common need in all fields.

## **Summary of Project Priorities**

### **Health**

The health sector has been greatly damaged during the last year and over the last decades, with serious consequences to the health of human beings. Restoration and modernization of the public health services are urgently required. The highest priorities are cancer diagnosis and treatment; genetic deformation, abortion and sterility; common diseases between humans and animals; and developing a system to provide statistics on health-related issues.

### **Water resources**

Water is essential to everyday life and was a major concern among all scientists interviewed. During the last decade, water has been heavily polluted. The highest priorities are monitoring water quality, waste water treatment, water recycling, and the water distribution infrastructure.

### **Environment**

The environment has been a major casualty of decades of war in Iraq. The highest priorities are environmental characterization, restoration and disposal of radioactive waste, hazardous waste,

and municipal waste; methods to deal with agricultural and industrial pollution, especially its effect on drinkable water; research on environmental-health related issues; and restoration of the marshes.

### **Engineering**

Multidisciplinary aspects of engineering need strengthening. However, among urgent priorities are housing for the poor, low cost building materials, and corrosion treatment.

### **Energy**

Energy is essential both for development and for an acceptable standard of living. The urgent priorities are generating, transmitting and stabilizing electricity distribution to all citizens, and improving the quality of petrochemical-based fuel.

### **Agriculture**

Iraq has rich agricultural resources that could be much better utilized. Iraqis emphasize the need to link agriculture with the environment and study a means of improvement for both concurrently. The highest priorities in this area are application of bio-technology, genetic engineering and tissue culture technologies for production and saving date-palm trees; integrated pest management, and seed preservation and improvement programs.

### **Veterinary & Livestock**

From the large number of projects proposed in this area, the highest priorities are: development of local capabilities for artificial insemination; development of fish-farming projects (Iraq has plenty of water resources, but the environmental damage has decimated this resource); improved breeding (cows, buffalos, sheep, etc.) to improve the genetic standards of local cow and buffalo herds; and developing vaccination programs that are currently not available (the intention is to have vaccines locally manufactured and implemented).

### **Biotechnology & Genetics**

Biotechnology and genetics research requires expensive tools and materials. Both have been unavailable for the last few years. Biotechnology and genetics research are important to other



scientific fields, particularly human health. Priorities in this category include: the preservation of genetic materials, genetic treatment for tumors and leukemia, and the ability to locally produce materials for biotech and genetics research.

### **Communications**

For the development of any country today, communication is essential. Iraq has been largely left out of the vast advancements in this field over the last decade. Accordingly urgent priorities in this field are: telephone communications, internet services, and data networks.

### **Applied Material Science**

This field is also of significance to the Iraqi science and technology community. It works to make the best of the materials that already exist in Iraq, and to use materials for various technological purposes. The priorities are as follows: construction materials, bio-materials, and polymeric matter.

### **Basic Science**

Priorities in this field include: research into the application of satellite remote sensing to detect and characterize environmental problems, to identify new resources, and for urban planning; retraining of teaching staff and establishment of up-to-date methods for teaching basic sciences; and development of education and training programs for mathematicians.

### **Information Technology (IT)**

IT has become one of the prominent scientific fields in the world today, but illiteracy in this field is high in Iraq. Iraq urgently needs IT training programs. Priorities in this field are development of education and training programs in IT and computer engineering; preparing staff and labs for establishing IT training centers, and development of expertise in computer and data security to allow full participation in the electronic age.

## **General Observations**

Any effort to engage and develop the Iraqi scientific community must recognize a number of problems associated with the long-term isolation of Iraqi science. Among these are the following:

- Generational education gaps;
- Severe stress in the scientific community;
- Lack of infrastructure and jobs;
- Scientists are leaving the country; and
- Confusion about the role of new organizations promoting S&T in Iraq.

On the other hand, the long isolation has also produced a highly innovative, practical technical community, with skills that could be of great value to the rebuilding process. The following points should be kept in mind:

- The Iraqis have significant previous experience in rebuilding;
- Iraqi scientists have previous experience in planning;
- Iraqi innovation can contribute to international S&T; and
- Iraq could be a place to market new technology products.

The ASTF/CMC initiative has the potential to make significant positive change in Iraq. As we move forward to the next stage, these recommendations should guide our efforts:

- Cultivate Iraqi scientists living abroad to initiate international cooperation;
- Include all Iraqi scientists in the initiative;
- Require detailed project proposals to emphasize the need for competition to obtain money for scientific projects;
- Clearly define the role of the governing authority; and
- Start the process now as Iraqi scientists can accomplish meaningful work even in the current conflict situation.

In Phase 2 of this initiative, the partners (ASTF & CMC) will coordinate with other ongoing initiatives internationally to identify common interests and invite their participation. They will also identify funding sources for particular project areas, visit potential international funding

organizations to discuss mutual interests and funding options; and plan and conduct the workshop. They will also seek official endorsements by international organizations, such as UNESCO.

The workshop will bring Iraqi scientists together with potential donors and collaborators to:

- Refine priorities and plan for development of full proposals;
- Announce the establishment of funding that is available to the Iraqi S&T community for selected priorities; and
- Agree on a mechanism to administer those funds, identify the managing entity, and name a committee to oversee the processes.

In preparation for the workshop, the partners will refine the list of potential topics, based on the interest of potential funding organizations; publicize the workshop; and invite critical parties to participate. They will also draft a framework for administering project funds, which will include recommendations for a merit-based approach to selecting projects for funding.

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# Report on the Priorities of the Iraqi Science and Technology Community

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## 1. Project Description

Rebuilding the communications, power, public health, and security infrastructure in Iraq remains an urgent priority. In the rebuilding process, it is important to insure that Iraqi scientists are engaged in legitimate activities that direct their knowledge to the benefit of their country.

The Arab Science and Technology Foundation (ASTF) and the Cooperative Monitoring Center (CMC) at Sandia National Laboratories developed a partnership to identify, contact and engage the Iraqi science and technology (S&T) community. The goals for the cooperative program include:

- Developing joint science and technology projects that engage Iraqi scientists in peaceful research and development activities;
- Engaging Iraqi experts to solve local problems; and
- Developing new Iraqi business opportunities that provide long-term sustainability to Iraqi S&T.

The initiative is divided into three phases. The first phase, the survey of the Iraqi scientific community, sheds light on the most significant current needs in the fields of science and technology in Iraq. Findings from the first phase will lay the groundwork for the second phase that includes the organization of a workshop to bring international support for the initiative, and simultaneously decides on an implementation mechanism. Phase three involves the execution of outcomes of the report as established in the workshop.

ASTF, a non-governmental organization (NGO), is well placed to undertake initiatives that engage the Iraqi S&T community. ASTF conducted its work for this project through the participation of highly qualified team members with direct knowledge of Iraqi institutions and the people employed therein. Knowledge of the language and personal contacts are valuable assets enjoyed by ASTF. Members of ASTF team are employed in the academic and research

institutions of Arab countries, the United States, and Europe. They are people known for their integrity and good will towards their collective objective. Over the years they have formed friendships in all walks of life in Iraq and their commitment to a prosperous and peaceful Iraq is beyond doubt.

In addition to the ASTF/CMC partnership, there are many additional efforts to revitalize the science community in Iraq. A partial summary of these efforts is included in Appendix A. Coordinating with these and other ongoing efforts will be a high priority in Phase 2 of the initiative.

## **2. History of Iraqi S&T**

Within two decades of independence (in 1921), the kingdom of Iraq established colleges of higher education in Law, Art, Engineering, and Medicine. By the **early fifties**, university education centered on the University of Baghdad, which came to encompass twelve colleges; various ministries set up their own research institutes. During this time a considerable number of degree holders (Ph.D. and M.Sc.) began to return to Iraq from England, France, Egypt, Lebanon and the US, with specializations in basic sciences, engineering, medicine and economics. In the **early sixties** provincial universities were established, and graduate programs were started in almost all of the Iraqi universities.

**In the seventies**, additional universities were inaugurated along with a number of individual colleges and over 80 High Technical Institutes. This was accompanied by the expansion and enlargement of the Scientific Research Foundation, R & D Centers, and commissions within the ministries. These were seriously encouraged and financially supported, and included the Military Industrial Commission (MIC), which had enlarged dramatically in the seventies and eighties, along with the Nuclear Research Center and the Nuclear Reactor Activities. In the **late seventies**, thousands of scientists, engineers, technicians, and other professionals in various disciplines, obtained scholarships and fellowships for degrees or intensive training in most of the advanced sciences, technologies, and informatics. In addition, professional societies, unions, and regional associations emerged, and many UN projects in science and technology were undertaken.

**At the beginning of the eighties**, a new body called the Scientific Research Council was formed and attached to the Prime Minister's Office. It was strongly supported, and contained most of the scientific centers, in addition to the well-equipped scientific documentation center, with its notable infrastructure and facilities. The SRC was the organizing body, setting up the science and technology strategy and policies, and coordinating 5-year National Research plans. The SRC also established the powerful National Computer Center, devoted to research, technology, and training.

**The Iran – Iraq War**, which lasted eight years (1980-1988), was costly to the country in both lives and resources. The financial losses have been estimated at \$100 billion.<sup>1</sup> Most of the basic and applied scientific activities were merged with the military logistics and services. This included the weapons of mass destruction (WMD) programs, and all fields of science, technology, and informatics.

**At the end of the eighties**, the decline reached its peak, and by the beginning of the **first Gulf War**, the Scientific Research Council was liquidated. The nuclear reactor and the Nuclear Research Center were destroyed in the war. Along with the advanced facilities and infrastructure of the Military Industrial Commission, R & D Centers and other technological infrastructure were also severely damaged. This had direct implications on the research activities in Iraq.

**During and after the first Gulf War and during the nineties**, Iraq lost a huge number of its scientists, technologists, and engineers.<sup>2</sup> In the wake of the exodus, the authorities recognized the importance of scientists' contributions to the civilian sector. Therefore, after 2000, new laws were issued to allow Iraqi scientists and researchers to act as consultants and carry out applied research for the benefit of public companies and ministries activities. The contributions of the civilian scientists enhanced the efficiency of Iraqi industry and increased its productivity.

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<sup>1</sup> Center for Nonproliferation Studies, 2002.

<sup>2</sup> For example, the Engineering Department at the University of Baghdad had 12 faculty members in 1990. All were PhD graduates of reputable international universities. During the sanctions, the number of staff dropped to 4. Another example can be found in the Mathematics Department at Al-Mustabseriah University. Before the 1<sup>st</sup> Gulf War there were 20 PhD staff members. This number dropped to 8 in 2003 and further decreased to 6 afterwards. Examples of this nature can be found across the country.

Due to the success achieved by Iraqi scientists in the 1990s several national research programs were recommended: the National Program for Drug and Reactive Materials; the National Program of Membranes; the National Program of Medical Plants; the National Program of Casting Materials; and the National Program of Polymers. Universities were founded in many provinces including Al-Nahrain University (Former Saddam University), which was considered the top among them and rated as a school of excellence, in addition to more than 5 universities, 54 colleges and 108 departments. This relative explosion of programs and education programs was a direct result of Iraq's isolation from the rest of the scientific community.

**The second Gulf War** was accompanied by the destruction of a number of S&T infrastructures in the country, followed by fires, looting, and demolition of equipment, libraries, museums, and buildings etc. This sector has truly collapsed almost to the zero line.

### **3. Team Members**

The Arab Science and Technology Foundation invited a number of distinguished Arab and Iraqi experts with diverse expertise to form the International Team. The following team members offered their time and effort to help the Iraqi scientific and technological community:

- **Dr. Abdalla A. Alnajjar** has a PhD in Applied Physics. He is the president of the Board of Directors of ASTF. He is also the Director of the Research and Studies Center in the University of Sharjah. His field of interest is material science and renewable energy. He is a citizen of the UAE. He is the project leader for the survey and was in Iraq for the second survey (March 21 – March 30, 2004).
- **Prof. Hamid M. Al-Naimiy** has a PhD in Astronomy and Space Sciences. He was the director of the Space and Astronomy Research Center in the Iraqi Scientific Research Council for approximately nine years. He is currently the Chairman of the Physics Department at the United Arab Emirates University, Al-Ain. He is an Iraqi citizen. Dr. Al-Naimiy was in Iraq for the first survey visit (January 20 – February 10, 2004) and the second survey visit.



- **Dr. Samir H. Al-Shakir** has a PhD in Food and Agriculture. He was the Dean of the College of Agriculture in Baghdad University. He was the Director of the Agriculture Research Center in the Iraqi Scientific Research Council. He was the Iraqi representative in the Food and Agriculture Organization in Italy for approximately 4 years. He is currently the Technical Director of Al-Saad Date Production Plant. He is an Iraqi citizen. Dr. Al-Shakir was in Iraq for the first and second survey visits.
- **Prof. Samir J. Al-Bader** has a PhD in Electrical and Electronic Engineering. He is a Visiting Professor at the Imperial College of Science, Technology and Medicine, London, UK. He has a wide background in education, research, and consulting. His current interest is in Optical Communications and nano-technology. He is a British citizen of Iraqi origin. Dr. Al-Bader was in Iraq for the second survey visit.
- **Engineer Ammar M. Munir** has M.Sc in Electrical Power System Engineering. He has been a senior photovoltaic engineer in the Solar Energy Research Center for about nine years. He is currently the officer of Scientific Programs in ASTF. He is an Iraqi citizen. Mr. Munir was in Iraq for both survey visits and also for a probative visit in August 2003. He is also the report facilitator.
- **Dr. Mustafa Al-Ghazali** has a PhD in Microbiology. He was a researcher in the Biology Research Center in the Iraqi Scientific Research Council. He is currently an expert in food testing in the Abu Dhabi Municipality. He is an Iraqi citizen.
- **Prof. Mahmoud M. Al-Kofahi** has a PhD in Nuclear Energy. He has wide experience in scientific research programs. He is currently the Dean of Applied Science in Al-Balqa'a University in Jordan. He is a Jordanian citizen.
- **Dr. Nader M. Ghazal** has a PhD in Business Administration. He has previous experience in planning survey programs. He is currently president of an investment consultancy company and a faculty member at the American University of Beirut. He is a Lebanese citizen.
- **Prof. Fathi H. Ghorbel** has a PhD in Mechanical Engineering and expert in mechanical and robotic systems. He is currently a faculty member at Rice University. He is a Tunisian citizen.

- **Dr. Ala J. Al-Douri** has a PhD in Physics. He was a senior researcher at the Solar Energy Center in the Iraqi Scientific Research Council. He also headed the Solar Energy Research Center in Iraq for about six years. He is currently a faculty member in the College of Science and Art in Sharjah University. He is an Iraqi citizen.
- **Dr. Falah H. Redha** has a PhD degree in Veterinary Science with over 18 years of experience in the medical device industry. He is currently the Director of the Center of Innovative Technology in King Faisal Hospital and Research Center in Riyadh. He is a Swiss citizen of Iraqi origin. Dr. Redha was in Iraq for the second survey visit.

In addition to this international team, ASTF invited a few distinguished Iraqi scientists to take part in the study because of their knowledge and enlightened understanding of past and current S&T activities in Iraq. The following participated as local team members:

- **Prof. Georgius A. Adam** has a PhD in Industrial Chemistry. He is the founder of the Iraqi Polymer Society. He has registered 40 industrial patents. He also has undertaken to establish the Thermal Refractory Projects in Basra along with 30 other industrial projects on pilot and semi-pilot plants.
- **Prof. Dakhel Hassan Jrew** has a PhD in Electrical and Electronic Engineering from Brunel University. He has headed many national scientific and technical committees in Iraq. He is a past president of Basrah University and the University of Technology in Baghdad. He is currently the vice-president of the Academy of Sciences in Baghdad.
- **Prof. Fawzi Al-Neima** has a PhD in Electrical Engineering from Newcastle University, U.K. Formerly a staff member at the Military Technical College in Baghdad, he is currently the Dean of the College of Engineering at Al-Nahrain University.
- **Dr. Shaker A. Abdulla** has a PhD in Astronomy Physics from the UK. He was a researcher at the Astronomy Research Center in the Iraqi Scientific Research Council and then served as the director general of the Iraqi General Commission of Meteorology. He also served as the general secretary of the Ministry of Communication. Based on his wide experience in the Iraqi telecommunications sector, he is currently a technical advisor in Iraq.
- **Prof. Laith Ismail Namiq** has a PhD in Civil Engineering. After finishing his degree in the United States, Dr. Namiq worked as a staff member at the College of Engineering at

Baghdad University and was eventually named Dean. He is a past president of Al-Nahrain University. He is a member of the Academy of Science in Baghdad.

- **Dr. Sawsan Ali Majid** has her PhD in Animal Breeding from the US. She was a scientific researcher in the Agriculture and Water Resources Center at the Iraqi Scientific Research Council in Baghdad, and then headed the Animal Husbandry Department at the Agricultural Research Center in the Ministry of Agriculture. Currently she is the principal deputy of the Ministry of Agriculture in Iraq.

- **Dr. Sameim Al-Dabbagh** has a PhD in Epidemiology from the UK. He is the acting president, staff member and dean of the Medical College at Mosul University.

The following participated by editing the report:

- **Prof. Najeh M. Khalil Al-Rawi** has a PhD in Civil Engineering from the US. He was the Minister of Iraqi Industrial Ministry and is a past president of the Scientific Research Council. He is a member of the Academy of Sciences, and is a past president of the organization. Dr. Rawi is considered to be one of the genuine leaders of legitimate scientific research in Iraq during the 1980s.

- **Dr. Jafar Thea Jafar** has a PhD in Physics from the UK. He was a principal in the Iraqi nuclear program (prior to 1990) and then a scientific advisor to the presidential Diwan. He has also served as the supervisor of the electricity sector.

- **Prof. Munther Al-Tikriti** has a PhD in Electrical Engineering from the UK. Formerly a staff member and head of the Control Engineering Department at the University of Technology in Baghdad, he also headed the Electronic Research Center at the Scientific Research Council in Baghdad. Currently he is a staff member and head of Electrical Engineering at Al-Mustansiriya University and a member of the Academy of Sciences.

- **Dr. Hilal Al-Bayati** has a PhD in Mathematics and has served as the President of the National Center for Computing in Baghdad. He was also the head of administration and training for all of the ministries. He currently is president of an information technology company.

- **Dr. Kamal Khoshnaw** has a PhD in Horticulture from the UK. He is a staff member, head of the Horticulture Department and president of the University of Sulaymaniyah.

## **4. Methodology**

The development of this report went through many carefully conducted stages; the main stages are highlighted below.

### **4.1 Preparatory Meeting**

The international team held its first meeting on January 13, 2004. In the absence of reliable information on the Iraq's current S&T community, a survey of the state of this community was formulated to form the necessary basis for future action towards fund raising. The survey was conducted by a survey team through soliciting proposals and ideas from Iraq's scientific community with a short questionnaire. Interviews with senior academic personalities were also planned when members of the survey team were in Iraq. A copy of the survey forms is located in Appendix B.

### **4.2 First Survey Visit (January 20 – February 10, 2004)**

The team started their mission on January 19, 2004. Upon arrival in Iraq they established a temporary office in Baghdad. As part of the initiative and based on outcomes of communications with the Iraqi S&T community, the team realized that having an office in Baghdad would make it easier for community members to communicate with the initiative sponsors. Full-time staff was hired for two months. While many scientific institutions offered to host the office, the Iraqi Academy of Science was chosen as the location because of the neutral historical role played by the Academy. This office partially solved the communication problem both locally and internationally. Further, the office assisted with following up on project collection and database formation.

Because of the destruction, burning and looting of many governmental buildings, the team found that most of the ministries and S&T institutions (excluding Universities) had been moved to alternate locations. Some of the main streets and bridges in Baghdad were closed for security reasons. This made the streets slow, crowded, and full of aggressive and chaotic driving. The roads were not safe, and many of the visited places could be potential targets for attackers.

For the above reasons it was not easy for the team to get access to the targeted S&T entities in a routine way. Accordingly, the team members relied on their personal relationships with the

Iraq's S&T community. This turned out to be the most successful means to conduct the mission and get access to the core personnel involved in Iraqi S&T programs. Other key factors were the welcoming response of the S&T community to the initiative's goals, its international mandate, and the involvement of an Arab NGO (ASTF).

To safeguard against any misinterpretation of the mission, and to be able to review the full S&T status, the team did its best to visit selected institutions in the north, west and south, even though most of the S&T institutions are located in Baghdad. During this field survey period, from January 20 until February 10, 2004, the team interviewed more than 130 persons including ministers, advisors, chancellors, deans, director generals, senior scientists, academics, researchers, and others. A full list of interviewed individuals is located in Appendix C. A wide spectrum of S&T sectors were covered by the survey, including science, engineering, health, environment, water, and others.

#### **4.3 Development of the First and Second Draft**

The first draft of the report was completed by March 15, 2004. Much of the report comprised the collected project ideas, interview reports with potential proponents, and solicited articles authored by well known figures of the S&T community in Iraq. The material was reviewed by members of a second survey team (March 15-20, 2004) and the project ideas were categorized according to the field of specialization. Research proposals in each category were tentatively evaluated based on priority and classed according to the mode of execution as:

1. Proposals that could benefit from international collaboration;
2. Proposals that directly address local needs (social, environmental, health, etc); and
3. Proposals that have a potential for business opportunities.

#### **4.4 A Three-Day Workshop**

Prior to the second survey trip to Iraq, five of ASTF team members held a three-day workshop to study received projects. This study allowed the group to:

1. Eliminate non-relevant proposals;
2. Cluster the 450 projects into 12 S&T categories;
3. Gather related projects into unified proposals; and
4. Summarize project ideas to fill the predefined one-page form on each project.

This extensive effort helped to identify clearer ideas on what should be targeted for the second survey visit.

#### **4.5 Second Survey Visit (March 21 – March 30, 2004)**

Some of the team members took part in the second survey, which established extensive connections and brought valuable feedback from inside Iraq. As a result of the earlier two trips, data shortages were identified and further connections proved to be needed for the success of the project. It was felt that a proactive role should be under-taken by the second survey aimed to:

1. Solicit more proposals in areas of strategic importance;
2. Request reports on areas that have been insufficiently addressed by the outcome of the first survey;
3. Invite S&T Iraqi community members to take part in the evaluation process of the second draft;
4. Request members of the S&T community to rank projects related to the initiative in terms of priority to their current situation;
5. Identify selected scientists with overall knowledge on S&T issues to proofread the second draft of the report; and
6. Establish direct contacts with Iraqi ministers and involve executives (second and third level) in related ministries to ensure continued support to the initiative.

Once in Iraq, the team covered three main geographical areas of Iraq: south, central, and north. Starting with Basra, the team delegated two members to contact distinguished individuals and local institutions. The bulk of the survey team traveled to Baghdad (central). They also visited Sulaimanya (northeast of Karkouk) and delegated a third member to continue visiting other related entities in the Kurdish region. The team, in spite of the limited durations of the visit and the chaotic situation in Iraq, conducted many important meetings. The team used daytime for visits and interviews, and nighttime to reconvene, discuss feedback, and plan for the next day's visits. Many distinguished individuals were interviewed; a selected list includes the:

- Minister of Planning and Development Cooperation, Dr. Mehdi Hafed, and a team from his ministry.
- Minister of Science and Technology, Dr. Rashad Mandan, and executive individuals in his ministry.

- President of the Ex-Scientific Research Council, member in the current Iraqi Academy, Dr. Najeh M. El-Rawi.
- Deputy Minister of the Ministry of Agriculture, Dr. Sawsan A. Al-Sherify (the Minister was met on an earlier trip to Iraq).

#### **4.6 Workshop in Baghdad on Iraqi S&T Priorities**

In addition to the formal and informal meetings, the survey team held a workshop in Baghdad. The workshop was attended by 26 key members of the Iraqi S&T community. Most of the specialists were given a copy of the project ideas; a few individuals received a full copy of the draft report. The workshop lasted four hours, and all attendees showed high motivation and enthusiasm.

After a short introduction to the initiative and international sponsors, an active and productive discussion took place. The participants were asked to:

- Negotiate community priorities;
- Prioritize the project ideas;
- Identify other projects of high-priority not listed among received projects.

In spite of the fact that time was a critical parameter to ensure covering all presented projects, nevertheless, attendees were cooperative and the workshop was very productive. The workshop was held on March 24, 2004 at the Al-Hamra Hotel in Baghdad.

#### **4.7 Iraqis Participation in Editing the Second Draft**

Being inside Iraq provided a good chance to validate the second draft of the project report. A few individuals inside Iraq are knowledgeable about the current and recent situation of Iraqi S&T. ASTF requested a number of them proofread the report. This was an important tool used by the team to insure validity of the details given in the report. Some of them gave valuable comments and offered to read the next draft of the report.

Once back in the UAE and having successfully concluded the second survey and obtained valuable comments on the draft reports, team members reconvened to finalize the Report on the Priorities of the Iraqi S&T community.

#### **4.8 Data Collection for the Report**

In summary, throughout the preparation stages of this report, many meetings and interviews were conducted. For a complete list of interviewed individuals, see Appendix C. The survey covered almost all related S&T entities.

Data collection took the following forms:

- Formal letters to ministries, institutions and universities
- Interviews (formal and informal)
- Correspondence
- Solicited reports from both individuals and cooperators
- Questionnaires.

To determine the priorities of the S&T community, the ASTF team followed the following sequence:

- Briefings of the project ideas were collected in groups of related scientific categories and listed on a form. Iraqi specialists in the field were asked to prioritize them.
- All projects were subjected collectively to the procedure described above, but given to a few experts who applied the same procedure collectively. This step helped to prioritize the project ideas as a whole.
- A workshop was held in Baghdad so the Iraqi S&T community was directly engaged in the prioritization of their needs.



## 5. Results and Findings

### ***5.1 Report on the Priorities of the Iraqi Science and Technology Community***

The survey team conducted a series of trips to Iraq during which they had contact with nearly 200 scientists from all sections of the country, representing all major Iraqi S&T specialties. As a result of these contacts, the survey team obtained over 450 project ideas from Iraqi researchers. These project ideas were revised and analyzed to identify priorities and crucial needs. These findings were later subjected to open discussion in a workshop attended by a number of distinguished community leaders and members. After refinement, the result is approximately 170 project idea summaries that have been categorized according to their suitability for 1) developing joint research projects with international partners, 2) engaging Iraqi scientists in solving local problems, and 3) developing new business opportunities. They have also been ranked as to high, medium, or low priority. We note that the project ideas should be considered as drafts, since writing competitive project proposals is an entirely new experience for many Iraqi scientists.

Project proposals were received in 12 S&T categories:

- |                    |                               |
|--------------------|-------------------------------|
| 1. Health          | 7. Veterinary and Livestock   |
| 2. Water Resources | 8. Biotechnology and Genetics |
| 3. Environment     | 9. Communications             |
| 4. Engineering     | 10. Materials                 |
| 5. Energy          | 11. Basic Sciences            |
| 6. Agriculture     | 12. Information Technology    |

Some overlap may exist between engineering and other technology-related categories. However, the engineering category was limited to subjects that are not covered in other categories.

Priorities were defined for each of the 12 subject areas, but from the perspective of the needs of the Iraqi community, the highest priority areas were found to be health, water, the environment, engineering (housing), and energy (electricity). Table 1 summarizes the highest priority project areas for each category.

**Table 1: Summary of High Priority Project Areas**

<b>S&amp;T Subject</b>	<b>High Priority Projects by Scientific Area (Shaded: highest priority based on Need)</b>
<b>Health</b>	Cancer diagnosis and treatment
	Genetic deformation, abortion, sterility
	Common diseases between humans and animals
	Statistics on health related issues
<b>Water Resources</b>	Water quality monitoring
	Waste water treatment
	Water recycling
	Water distribution infrastructure
<b>Environment</b>	Disposal and cleaning of radioactive, hazardous & municipal waste
	Pollution residuals
	Environmental health
	Marsh restoration
<b>Engineering</b>	Housing for the poor
	Low-cost building materials
	Corrosion treatment
<b>Energy</b>	Electricity generation, transmission, and stability
	Improvement of fuel quality
<b>Agriculture</b>	Date palm conservation
	Integrated pest management
	Seed preservation/improvement
<b>Veterinary &amp; Livestock</b>	Artificial insemination
	Fishery projects
	Improved breeding
	Vaccination programs
<b>Biotech &amp; Genetics</b>	Preservation of genetic material
	Genetic treatment for cancer
	Produce local materials for biotech and genetics research
<b>Communication</b>	Telephone communication
	Internet Services
	Data networks
<b>Applied Material Science</b>	Construction materials
	Bio-materials
	Polymeric materials
<b>Basic Science</b>	Environmental remote sensing
	Training professors in modern teaching methods
	Training mathematicians
<b>Information Technology</b>	Training in IT and computer engineering
	IT training centers
	Computer and data security

Survey teams received large numbers of requests to establish labs, centers, and, in some cases, colleges. This reflects the effect of looting that occurred after the fall of the ex-government. Rather than address these infrastructure needs explicitly in the survey, however, team members asked scientists to address specific infrastructure needs in the context of individual projects.

Once priorities for future work are determined, the question of necessary infrastructure will be addressed.

In addition to priorities for S&T, the survey team also emphasizes two general themes: 1) there is a generation gap between older and younger Iraqi scientists which should be bridged, and 2) Iraqi scientists will need help in adjusting to advancements of science that have occurred over the last two decades. Regarding the generation gap, older scientists were typically trained at internationally recognized institutions, whereas the younger generation has been trained almost exclusively within Iraq. The result is a significant loss of expertise, including a marked scarcity of mathematicians. Information technology expertise is also largely absent. Bringing the Iraqi scientific community up to date will require a specific focus on the younger generation, as well as updating the older generation. In addition, outdated equipment and techniques will need to be replaced. Capacity building for scientific personnel is a common need in all fields.

## ***5.2 Detailed Summary of Project Priorities***

### **Health**

The health sector has been greatly damaged during the last year, as well as over the last decades, with serious consequences to the health of human beings. Restoration and modernization of the public health services are urgently required. There is particular concern regarding colorectal cancer, breast cancer, bladder cancer, and disabilities (especially mongolism and infertility). Increases in hypertension, diabetes, tuberculosis (TB), Downs syndrome, and bone disease have also been noted. Lack of early diagnostic capabilities has led to large numbers of chronic cases, and the absence of facilities to diagnose viral diseases is another serious concern for medical doctors.

Suggested projects include:

- The establishment of a center to survey, analyze, and treat health problems, especially cancer and bilharzias. Development of a cancer cell line for treatment purposes was also suggested;
- Collection of statistical data and retraining of specialists in statistical methods; and
- Quality control of radiation in diagnostic therapy.

The four highest priorities are:

1. Cancer diagnosis and treatment;
2. Prevention of genetic deformation, spontaneous abortion and sterility;
3. Researching common diseases between humans and animals; and
4. Developing a system to provide statistics on health related issues.

### **Water resources**

Water is essential to everyday life and was a major concern among all scientists interviewed. During the last decade, water has been heavily polluted. Examples of projects that help solve these problems are:

- Research on the topic of water pollution (sewage, industrial, agricultural) with an emphasis on water treatment;
- Active monitoring system for water resources;
- Identifying non-river water resources, such as lakes and groundwater;
- Desalination;
- Artificial recharge of ground water from lakes or rivers;
- Waste water re-use for agriculture;
- Rehabilitation of water distribution infrastructure; and
- The relation of water to other environmental problems.

Highest priorities are:

1. Monitoring of water quality;
2. Waste water treatment;
3. Water recycling for various purposes; and
4. Water distribution infrastructure.

### **Environment**

The environment has been a major casualty of decades of war in Iraq. The following issues received attention of the scientific community:

- Establish baseline understanding of critical pollution problems;

- Characterize the problem of depleted uranium and develop a remediation effort, including development of a disposal site;
- Monitoring and controlling the quality of imported food to assure health and safety;
- Mitigating air pollution caused by uncontrolled transportation and old industries, especially cement and solid waste from cities;
- Development of healthy waste disposal sites, to replace the open dumping common in Baghdad and other major cities;
- Monitoring fertilizers and pesticides;
- Development of healthy environmental standards, through programs of surveillance and control;
- Reversing the impacts of war on the environment (e.g., the draining of the marshes).

The highest priorities are:

1. Environmental characterization, restoration and disposal of:
  - a. radioactive waste
  - b. hazardous waste
  - c. municipal waste;
2. Methods to deal with agricultural and industrial pollution, especially its effect on drinkable water;
3. Research on environmental health-related issues; and
4. Restoration of the marshes.

### **Engineering**

Multidisciplinary aspects of engineering need strengthening. However, among urgent priorities in this field are:

1. Housing for the poor;
2. Low cost building materials; and
3. Corrosion treatment.

### **Energy**

Energy is essential both for development and for good living. Current needs include:

- Electricity;
- Solar and wind energy;
- Cooling and air conditioning;
- Water projects to generate electricity; and
- Quantitative controls on energy distribution, rather than control by timing only.

Urgent priorities are:

1. Generating, transmitting and stabilizing electricity distribution to all citizens; and
2. Improving the quality of petrochemical-based fuel.

### **Agriculture**

Iraq has rich agricultural resources that could be much better utilized. In light of the tremendous need to develop this field, numerous project areas have been proposed, including:

- Restoration of the Iraqi date palms. Date palms are of great economic and cultural value in Iraq. There used to be 30 million trees, but currently the count is less than 16 million. The palm is endangered because of lack of care and damage to the environment. Restoration may require building a laboratory inside Iraq for tissue-culture.
- Integrated Pest Management (IPM) to reverse damage to the Iraqi agriculture sector. The emphasis would be on minimizing the use of chemicals in an environment that is already suffering.
- With reduced availability of irrigation water, finding plant varieties that resist salinity is increasingly important.
- Wood for construction is becoming a scarce and highly valued material. A program to plant and care for trees would add to the development of the local economy and assist in the rebuilding process.
- Seed technology is required to save local species that were looted and damaged during the collapse of the regime in Iraq.

Having listed some important lines for research and development in agriculture, Iraqis emphasize the need to link agriculture with the environment and study a means of improvement for both concurrently. Using tissue culture and advanced agriculture technologies to save local plants

traditionally used for medical purposes as an alternative medical method could contribute to the improvement of community health in Iraq, especially in rural areas.

From this long list, the highest priorities are:

1. Application of bio-technology, genetic engineering and tissue culture technologies for production and saving date-palm trees;
2. Integrated Pest Management; and
3. Seed preservation and improvement program.

### **Veterinary & Livestock**

From the large number of projects proposed in this area, the highest priorities are:

1. Development of local capabilities for artificial insemination;
2. Development of fish-farming projects (Iraq has plenty of water resources, but environmental damage has decimated this resource);
3. Improved breeding (cows, buffalos, sheep, etc.). The importance of the project lies in improving the genetic standards of local cow and buffalo herds; and
4. Vaccination programs that are currently not available (the intention is to have vaccines locally manufactured and implemented).

### **Biotechnology & Genetics**

Biotechnology and genetics research requires expensive tools and materials. Both have been unavailable for the last few years. Biotechnology and genetic research are important to other scientific fields, particularly human health. Subjects in this category include:

- Production of reactive materials as anti cancer drugs for use in the drug industries;
- Genetic treatment for cancer;
- Genetically modified foods, especially limits and standards for the use of these kinds of foods;
- Preservation of healthy genetics in implantation seed;
- Production of consumable materials for biotech research;
- Preservation of genetic materials;
- Production of saline-resistant plants; and

- Using biotech methodologies for research related to subjects of: production of bio-sensors, tissue engineering, and bio-environment.

Three high priority projects are:

1. Preservation of genetic materials;
2. Genetic treatment for tumors and leukemia; and
3. Ability to produce materials locally for biotech and genetics research.

### **Communications**

For the development of any country today, communication is essential. Iraq has been largely left out of the vast advancement in this field over the last decade. Accordingly, priorities in this field have been specified as follows:

- Establishing a wireless communication network in Iraq;
- Establishing a communication network among universities and institutes and linking them to the world. This project would be a particular help to the academic establishments in Iraq;
- Establishment of a data center that could include links to other institutions like banks, hospitals, etc; and
- Rehabilitation of communication training centers.

The most urgent priorities are:

1. Telephone communications;
2. Internet services; and
3. Data networks.

### **Applied Material Science**

This field is also of significance to the Iraqi science and technology community. It works to make the best of the materials that already exist in Iraq, and to use materials for various technological purposes, as follows:

- Geological exploration of raw materials;
- Petrochemical materials;



- Materials for solar energy technology;
- Development of new materials, e.g., composite materials and bio-materials; and
- Research on local materials in Iraq.

Among high priorities are:

1. Construction materials;
2. Bio-materials; and
3. Polymeric matter.

### **Basic Science**

Priorities in this field include:

- Research into the application of satellite remote sensing to detect and characterize environmental problems, to identify new resources, and for urban planning;
- Retraining of teaching staff and establishment of up-to-date methods for teaching basic sciences; and
- Development of education and training programs for mathematicians.

### **Information Technology (IT)**

IT has become one of the prominent scientific fields in the world today, but illiteracy in this field is high in Iraq. Iraq urgently needs IT training programs. Priorities in this field are:

1. Development of education and training programs in IT and computer engineering;
2. Preparing staff and labs for establishing IT training centers; and
3. Development of expertise in computer and data security to allow full participation in the electronic age.

### **5.3 General Comments and Observations**

Any effort to engage and develop the Iraqi scientific community must recognize a number of problems associated with the long-term isolation of Iraqi science. Among these are the following:

- Generational education gaps  
There are large educational gaps between roughly two generations of Iraqi scientists: those who received their degrees before 1990 from well established international

universities; and others who got their higher research training in Iraq during the embargo. Currently, leaders of the scientific community are mostly older than 50 years of age. Younger scientists have experienced many problems and may be influenced to use their scientific expertise for undesirable purposes. Keeping both generations engaged is important to steer Iraqi S&T towards efforts that will provide the greatest peaceful benefit to the country.

- Severe stress in the scientific community

Iraqi scientists are currently having a very difficult time. Depression is wide-spread within the community, with aggression a possible outcome. Examples of problems include:

- The abuse of the scientific establishment by the previous regime, including coercion to work on government-sponsored programs, discouragement from developing new ideas, and coercion not to cooperate with international inspectors during the years of the embargo;
- The deaths or departures of many of their colleagues;
- Feelings of uselessness in the effort to rebuild Iraq; and
- Great reduction in the standard of living.

- Lack of infrastructure and jobs

Leaders of the S&T sector must cope with the serious problem of large numbers of capable, unemployed experts. For example, the Minister of S&T emphasized the need for offices and facilities to host the 10,000 employees of his ministry. Currently office space exists for only one-fifth of the employees. The remaining numbers wait in gardens, car parks and lobbies around the ministry office to assure that they receive their pay. Some simply stay at home to avoid the chaos and the “jungle rule.”

- Scientists are leaving the country

An exodus of Iraqi scientists has been occurring for several decades and could accelerate. This represents a tremendous loss, as many of these scientists have significant experience with issues of local importance. As noted above, those who remain do not have an adequate work environment. The current wave of departures needs to be controlled and mechanisms for convincing expatriate scientists to return are needed. Many scientists

living outside the country have expressed interest in coming back to participate in the rebuilding process, but do not know where to start.

- Confusion about the role of new organizations promoting S&T in Iraq

Misconceptions and lack of trust exists between the newly suggested Iraqi Academy of Science and the Academy of Sciences that still exists in Iraq. There is great resentment towards expatriate Iraqis who now position themselves as leaders. A bridge should be built between these two groups.

On the other hand, the long isolation has also produced a highly innovative, practical technical community with skills that could be of great value to the rebuilding process. The following points should be kept in mind:

- Iraqis have significant previous experience in rebuilding

During the Saddam regime, Iraq was engaged in many devastating confrontations, during which the country's infrastructure was destroyed. The international embargo against Iraq forced Iraqi engineers and scientists to obtain experience in the rebuilding process. Good capabilities in engineering specialties exist in universities, colleges, and technical institutes. These played a role in manufacturing alternative tools and spare parts that were banned by the international community for importation into Iraq. Many of these skills are available, but are not being utilized. These skills, coupled with advanced technology, could greatly speed the rebuilding process.

- Iraqi scientists have previous experience in planning

During the embargo period, the ruling authorities started many S&T programs to compensate for isolation and invested heavily in S&T, building advanced labs and sending the best of their youth abroad for education. The scientific community was involved in two major National Plans (1985-1990 and 1999), and could now invest this expertise in planning for the new Iraq.

- Iraqi innovation can contribute to international S&T

For the last decade, Iraq has been practicing S&T aggressively in isolation from the world. Although Iraqis did not have access to the latest technologies, they have developed novel methods to resolve problems that may be valuable in other parts of the world. The international scientific community should develop closer ties to these

intellectuals to make use of their accumulated expertise. In addition, ties between scientists and technology development organizations could develop this expertise to create new business opportunities.

- Iraq could be a place to market new technology products

After being isolated from the world for the last 13 years, Iraq is now eager to get new technologies and training. In a country with a population of 24 million, there is ample space for adaptation of new technologies and marketing activities. It is time for international companies to provide contributions that would lead to adaptation of their technologies and further widen their international market share.

## 6. Recommendations

The ASTF/CMC initiative has the potential to make significant positive change in Iraq. As we move forward to the next stage, these recommendations should guide our efforts.

- ***Cultivate Iraqi scientists living abroad to initiate international cooperation***

All of the Iraqi scientists interviewed (from technicians to full professors) are highly motivated to participate in scientific and technical endeavors. Regarding leadership, particular attention should be given to scientists who were in the country in 1991, whether they are still in the country, or living in another country, because of the likelihood of their having more advanced scientific training. Scientists that left the country during the embargo period could be an excellent resource for Track 1 projects (Development of Joint Research Projects), especially if they currently work in established institutions that could provide needed facilities and resources.

- ***Include all Iraqi scientists in the initiative***

Throughout the development of this report, the survey teams were careful to involve all Iraqi scientists and engineers, with no exclusions. This should also guide the approach during the implementation period. Specifically, we recommend that this initiative be extended to those who were detained because of being associated with WMD programs or restricted because of their earlier relation to Ba'athism. For the most part, these persons have valuable experience and should be allowed to be engaged in peaceful activities stated in this report. In addition, Iraqi engineers and technicians hold excellent

practical and manual skills and should be strongly encouraged to become engaged in this initiative. Most of them are young and may be easily swayed toward irrelevant or illegitimate operations.

- ***Require detailed project proposals to emphasize the need for competition to obtain money for scientific projects***

The project ideas are condensed from a very large set of proposals received during Phase 1 of this initiative. This is an excellent first step toward identifying specific projects of interest. However, significant refinement would be required prior to funding. Therefore, it is recommended that once a subject area is decided upon for funding, a call should be made for detailed proposals. To assure that all members of the Iraqi S&T community can compete at this stage, the call should be distributed through a well defined network of entities and individuals. Winning proposals would be selected based on both scientific merit and on priority.

- ***Clearly define the role of the Governing Authority***

Whereas the continued strong support of government ministries and authorities will be critical for the success of this initiative, we recommend that this initiative be administered by an independent entity, such as the Initiative Core Committee. This will ensure that even government scientists are free to participate in international partnerships. In addition to information-sharing on all ongoing projects, the role of the government could include:

- Representation on the Initiative Core Committee (with ASTF, the CMC, and others);
  - Assistance with project implementation, including providing permits for international community to work with the Iraqi S&T community and to provide access to facilities; and
  - Establishment of mechanisms to directly fund scientific projects and exempt projects from taxes.
- ***Start the process now as Iraqi scientists can accomplish meaningful work even in the current conflict situation***

The Iraqi S&T community has an important role in bringing stability to the country. It forms a large skilled community that is generally not involved in the current disturbances, and that could be engaged in peaceful activities that would assist the rebuilding process

and could lead to a better standard of living in Iraq. Many of the problems facing the Iraqi people may be solved by means and tools employed by the scientific community. Given the uncertainties in the existing political situation, this initiative will need close monitoring, but the momentum generated by the survey team should not be lost. Identifying ways to begin engagement on the ground, even in very small ways, should be a top priority.

Very near-term activities could include:

- ***Developing mentorship programs to transfer experience from established to younger scientists***

The Minister of S&T made the important observation that transferring the expertise from the current privileged members of the S&T community to the many young scientists is critical. Such an activity could provide scientists that are more experienced with the opportunity to contribute to the rebuilding effort, thereby alleviating some of the depression and stress they are currently experiencing.

- ***Establishing international interface and involvement***

Iraqi research facilities need to be connected with similar centers worldwide. There is no doubt that Iraq has unique problems in which scientists on the international stage would be interested. At the present time the researchers in Iraq need collaboration and funding for all fields. In addition, security and environmental problems are by nature multi-national. To facilitate developing contacts, it is suggested that the international S&T community arrange meetings in various countries, specifically in the Gulf.

- ***Providing temporary opportunities abroad for Iraqi academicians***

If engagement in Iraq proves to be too difficult in the near term, Iraqi scientists with academic expertise could be provided with temporary safe haven in Arab and International institutions. They could be offered short or temporary contracts until the situation is settled inside Iraq, allowing them to go back to provide most needed support to their people. This is one way to safeguard highly valuable scientists from losing their expertise and living standards.

## 7. Next Steps

In Phase 2 of this initiative, the partners will complete the following next steps.

- ***Coordinate with other ongoing initiatives internationally to identify common interests and invite participation***

The partners will coordinate with other ongoing efforts to rebuild the Iraqi S&T community, both in the United States and internationally, to identify common interests and potential sharing of responsibilities. This coordination will also help plan the focus of the international workshop. Since proactive participation of the international S&T community will be essential to achieving the initiative's goals, special efforts will be made to invite their participation.

- ***Identify funding sources for particular project areas and visit international funding organizations to discuss mutual interests and funding options***

The partners will refine project priorities and identify potential sources of funding for particular project areas. It will visit potential international funding organizations and selected countries to discuss mutual interests and funding options. The goal will be to have funding for key priorities identified prior to conducting the workshop.

- ***Plan and conduct the workshop***

At the workshop, the initiative will

1. Bring Iraqi scientists together with potential donors and collaborators to refine priorities and plan for development of full proposals;
2. Announce the establishment of funding that is available to the Iraqi S&T community for selected priorities,
3. Agree on a mechanism to administer those funds, identify the managing entity, and name a committee to oversee the processes.

In preparation for the workshop, the partners will refine the list of potential topics, based on the interest of potential funding organizations; publicize the workshop, and invite critical parties to participate. The members of the initiative will also draft a framework for administering project funds, which will include recommendations for a merit-based approach to selecting projects for funding.

## **Appendix A: International Science & Technology Efforts for Iraq**

In the last few months, there have been several efforts to revitalize the science community in Iraq. The following is a brief summary of the known efforts in this area.

### **Iraqi Academy of Science (2003)**

London's Royal Society, the UK's national academy of science, hosted a meeting of British, US, and Iraqi Academics in November 2003 to establish a new scientific academy in Iraq. The Iraqi Academy of Science<sup>3</sup> is to be an "autonomous, self-governing organization of distinguished scientists dedicated to employing their talents for the advancement of science in Iraq." (BBC News, 12/1/2003). The new Iraqi Academy of Science has 12 founding members and planned to headquarter in Baghdad. During their meeting, the group adopted a charter and elected a standing committee whose purpose was to organize a meeting of the Academy's council in Baghdad in 2004. The charter envisions the Academy as "the leading scientific organization in Iraq promoting pure and applied science for the service of the people and the country, and reviving Iraqi talents for the good of the people." Nevertheless, this Academy is faced with difficulties, a few of which are that the majority of its members are expatriates who left the country many years ago and that the people inside Iraq are not in favor of an external effort that does not recognize long established efforts that have been taking place inside Iraq for decades.

The initiative to form the Iraqi Academy was additionally supported by the US National Academy of Sciences and the French Académie des Sciences. Currently, the Iraqi Academy does not have funds for projects, but has begun planning to secure funding sources inside Iraq.

### **Iraqi International Center for Science and Industry (IICSI)**

The US Department of State is working to form the Iraqi International Center for Science and Industry which is projected to identify needs and provide support for scientific and technical projects that will meet nonproliferation goals. IICSI intends to engage personnel formerly involved in Iraq's weapons of mass destruction programs and enable these scientists to serve in the rebuilding of Iraq. IICSI will work with a broad range of Iraqi agencies to identify the

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<sup>3</sup> This action, in essence, created a second science academy in Iraq which has created a great deal of tension among the scientific community. Iraqi scientists resent the creation of a new academy comprised of expatriots.



scientists from Iraq's WMD programs. This initiative will prevent Iraqi scientists and technical personnel from providing their expertise to countries of concern.

In the near-term, IICSI has planned five projects:

- a series of workshops corresponding to key Iraqi priorities (energy research, environmental protection, information technology, agriculture, chemical research and production, and industrial development) which would focus on how WMD experts could contribute to reconstruction activities;
- a series of seminars to identify and assess those in the Iraqi science community with WMD experience or related skills;
- interviews with WMD and selected non-WMD scientists to reveal the extent and nature of relevant expertise in the Iraqi community;
- contacts and engagements of WMD scientists and technical personnel in Basra and Mosul universities to develop engagement beyond the Baghdad region; and
- regional exchanges to facilitate regional dialogue between Iraqi scientists, technicians and engineers and their counterparts in the region for the purpose of accelerating progress on reconstruction issues.

Total funding for the IICSI near term efforts is \$2 million dollars, with an additional request for \$20 million.

### **Science, Technology, and Engineering Mentorship Initiative for Iraq (STEMII)**

STEMII is a program proposed by the Office of Science and Technology Advisor to the US Secretary of State. It proposes to establish a process and outreach program to the Iraqi science, technology and engineering community by promoting research and development in both higher education and in basic and applied research. The goal of STEMII is to redirect the Iraqi science community to the development of a peaceful and more democratic Iraq through the introduction of funding for professional activities not associated with WMD. Among the target population for STEMII are displaced or disenfranchised personnel from the old Iraqi Atomic Energy Commission and the Military Industrialization Commission (now enjoined in the new Ministry of Science and Technology), the Ministry of Higher Education and Scientific Research, and Iraqi universities and other organizations populated by science, technology and engineering personnel.

STEMII intends to create links between the Iraqi and American science, technology and engineering (STE) communities through a grant system based on R&D proposed by the Iraqi STE community. Projects would be designed for completion within one year or less, would be required to pass a peer review process, and would be mentored by American academic professionals. Funding levels for this proposal have not been released.

### **Other Proposals**

A variety of additional proposals have been developed for engagement with sectors of Iraqi society and portions of the S&T community. These proposals include initiatives for cooperation in revitalizing higher education, reestablishing a civil engineering professional body, training/retraining programs for former employees of the Iraqi Atomic Energy Commission and the Military Industrialization Commission, and rebuilding Iraq's agriculture sector, among others.

While other organizations are either working with the Iraqi science and technology community or developing proposals to do so, the ASTF/CMC effort is unique due to the comprehensive nature of the survey effort and the inclusion of Iraqis in the survey process. Additionally, this project is not solely devoted to redirecting former WMD scientists, but intends to engage the entire science and technology community. This survey effort is also the first to have generated a large number of specific proposals.

## Funded efforts in Iraq

Programs	Organization	Funding Source	Level of Effort	Notes
Iraqi Academy of Science		Private donors	Currently fundraising	Founded November 2003
Iraqi Center for Science and Industry	US Dept of State	US Gov.	\$2 million, (request for additional \$20m)	Engage and redirect WMD scientists (based on Russia/NIS model).
Science, Technology, and Engineering Mentorship Initiative for Iraq	US Dept of State	US Gov.	Proposed	Mentor scientists and engineers into peaceful S&T activities.
Rehabilitation Assistance Facility Iraq	AusAID	Gov. of Australia	unknown	“Technical support for Iraqi ministries and the key international agencies involved in reconstruction efforts.” See <a href="http://www.rafi.sagric.com/content.htm">www.rafi.sagric.com/content.htm</a>
Electricity Network Rehabilitation (ENRP)	UNDP	Oil-for-Food program	1 Billion (since 1997)	Program now administered by the CPA.
Dredging & wreck removal from Umm Qsar port	UNDP	UNDP, Gov. of Japan, others. Discussing project expansion with private donors.	\$50.1 million	Enable the large scale delivery of humanitarian supplies.
Rehabilitation of Hartha (Basra) power station and transmission system	UNDP	Gov. of Japan	\$8 million	Will involve international and local engineers and specialists.
Iraq Reconstruction and Employment Programme (IREP)	UNDP	UNDP, Gov. of Japan	\$1 million, UNDP \$6 million, Japan	Includes basic social infrastructure repairs and facilitates jobs for poor and disadvantaged.
Water and sanitation	UNDP	European Commission Humanitarian Affairs Office	\$4.4 million	Repairing pumping stations, clearing waste and cleaning sewage system, fixing breakages in water supply networks.
Rehabilitation of Al-Kadhimiya Teaching Hospital, Baghdad	UNDP	Gov. of Japan	\$3.6 million	In coordination with the Iraqi Ministry of Health and Ministry of Higher Education
Humanitarian aid	UNICEF	Multiple	\$182.7 million	Projects in water, sanitation, health and nutrition, education, and child protection.
Reconstruction contracts	USAID, DOS, DoD	US Gov.	\$18.6 billion (FY04)	Details can be found at <a href="http://www.export.gov/iraq">www.export.gov/iraq</a>
Humanitarian aid	ECHO	European Commission	\$125.7 million (€100 million)	Funds channeled through European NGO's, UN agencies and the Red Cross

## Appendix B: Data Collection Forms Used in the Surveys

### Form 1

An International Initiative Towards:

### ENGAGING IRAQ'S SCIENCE & TECHNOLOGY COMMUNITY

Field: *{field title}*,

Please, find attached (15) research proposals in the Area specified above “*{field title}*”. Please, examine these proposals together with the commentary (attached) and classify them in order of “Priority” as (High, Medium, Low). Please, write your relevant remarks in the table bellow. You may write further comments on the bottom of this page or on added pages. Please indicate in the column marked “Type” if the project is be served as:

- 1- International Collaborative Research            C
- 2- Project aimed at Solving Local Problems      L
- 3- Business Oriented Project                            B

You may propose other projects of similar nature and suggest a “Priority” and “Type” for them as above.

P: Priority

No.	Project	Type C, L, B	Priority H, M, L	Remarks
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Further Comments:

.....  
 .....

**Form 2**

**Project Summary Form**

**Field :** (Health, Biotech & Genetics, Veterinary & Livestock, Agriculture, Energy, Water, Environment, IT, Communication, Engineering, Material Science, Basic Sciences)

**Title :**

**Objectives:**

- .....
- .....
- .....

**Justification:**

**Available Resources:** (HR and Facilities)

- .....
- .....
- .....

**Beneficiaries :** (Public, Iraqi S. Community, etc)

- .....
- .....
- .....

**Involved Iraqi Entities:** (Ministries, Universities, R. Centers, ..... etc)

- .....
- .....
- .....

**Requirements:** (any special req. like expertise, labs, funds, ..... etc)

**Deliverables :**

## Appendix C: List of survey participants

### Visited Institutions & performed Interviews during the Survey (Baghdad-Mousel-Basrah-Arbil-Sulaimaniya-Alanbar)

#### Iraqi Academy of Science

- |    |                                |                   |
|----|--------------------------------|-------------------|
| 1. | Dr. Abdulhaleem I. Al-Hajjaj   | Secretary-General |
| 2. | Prof. Mahmood Hayawee          | President         |
| 3. | Prof. Dajhil H. Jerew          | Vice-President    |
| 4. | Prof. Najih Al-Rawi            | Member            |
| 5. | Prof. Laith Ismail Namig       | Member            |
| 6. | Prof. Tarik I. F. Al-Juboori   | Member            |
| 7. | Prof. Munther Naman Al-Tikriti | Member            |
| 8. | Prof. Ali Attiya               | Member            |

#### Ministry of Higher Education

- |     |                               |          |
|-----|-------------------------------|----------|
| 9.  | Dr. Ziad Abdel Razzaq Aswad   | Minister |
| 10. | Dr. Mohammad Abdulla Al-Najem | Advisor  |

#### Baghdad University

- |     |                            |           |
|-----|----------------------------|-----------|
| 11. | Prof. Mousa Jwad Al-Musawi | President |
|-----|----------------------------|-----------|

#### College of Science

- |     |                                     |  |
|-----|-------------------------------------|--|
| 12. | Prof. A. T. Rahmatalla              | Dean                                   |
| 13. | Prof. Mazin Yousif Tamar-Agha       | Head of Geology Department             |
| 14. | Prof. Saleh Mahdi Ali               | Head of Remote Sensing unit            |
| 15. | Prof. Moutaz Abdul-Sattar Al-Dabbas | Professor of Geology & Researcher      |
| 16. | Prof. Muqdad H. Al-Jabbari          | Professor of Geology & Researcher      |
| 17. | Prof. Raad M. Muter Al-Molla        | Head of Biology Department.            |
| 18. | Dr. A. M. Suhail                    | Group leader of Photoelectric research |
| 19. | Dr. Maysoun F. Alias                | Physics Department                     |

#### College of Engineering

- |     |                     |      |
|-----|---------------------|------|
| 20. | Dr. Ali Al-Kiliddar | Dean |
|-----|---------------------|------|

#### College of Science for Women

- |     |                          |      |
|-----|--------------------------|------|
| 21. | Prof. Anis Malik Al-Rawi | Dean |
|-----|--------------------------|------|

#### College of Agriculture

- |     |                         |      |
|-----|-------------------------|------|
| 22. | Dr. Ahmed H. Al-Zubaidi | Dean |
|-----|-------------------------|------|

#### College of Medicine

- |     |                           |   |
|-----|---------------------------|---|
| 23. | Dr. Fakhri M. Al-Hadeethi | Iraqi commission of medical specialties |
|-----|---------------------------|---|

#### University of Technology

- |     |                  |                 |
|-----|------------------|-----------------|
| 24. | Dr. K. S. Krikor | Vice-chancellor |
|-----|------------------|-----------------|

### **Architectural Engineering Dept.**

25. Dr. Khalil Ibrahim Ali Head

### **Mechanical Engineering Dept.**

26. Dr. Mohammad N. Al-Fattal Head

27. Dr. Ahmad Al-Bairouti The Scientific assistant

### **Electrical Engineering Department**

28. Dr. A. K. Al-Shaikhli Head

### **Center of Training and Workshops**

29. Prof. Mohammed J. Al-Tornachi Director

30. Eng. Firas S. Abdul-KAder Technical Education Department

### **Al-Rasheed College for Engineering & Science**

31. Prof. Mouayed Aziz Hasan Head

32. Dr. Siddeeq Y. Ameen Computers & Information Dept.

## **Al-Nahrain University**

### **College of Engineering**

33. Prof. Fawzi M. Al-Naima Dean

34. Prof. Albert Yousif Namaan Head of Medical Engineering Dept.

35. Prof. Riyadh J. Aziz Head of Civil Engineering Dept.

36. Prof. Qasim J. Slaiman Head of Chemical Engineering Dept.

37. Prof. Raad Sami Fyath Head of Laser & Opto-Electronic Eng. Dept.

38. Dr. Abbas Ahmed Al-Shalchi Head, Electronic & Communication Eng. Dept.

39. Dr. Hisham Tawfiq Head of Mechanical Engineering Dept.

40. Dr. Mohammed Z. Al-Faiz Head of computers Engineering Dept.

41. Dr. Saher M. Al-Kaissi Head of Architectural Engineering dept.

42. Dr. Mohammed Nassif Latif Vice Dean for Admin & Finance

43. Dr. Talib Kashmoula Assistant Professor of Chemical Engineering

44. Prof. Raid Ramzi Al-Omari Professor of Civil Engineering

45. Dr. Mohammed Baqir Ash-shadidy Assistant professor of Civil Engineering

### **College of Science**

46. Dr. Laith A. Al Ani Dean

47. Dr. Khulood W. Al-Samarae Head of Biotechnology Dept.

### **College of Medicine**

48. Prof. Tarik I. Al Jeboori Dean, College of Medicine

### **College of Information Technology**

49. Dr. Nasser N. Al-Ani Vice Dean

### **Al-Mustansiriyah University**

50. Dr. Mohammed Yahya Al-Ani Vice-Chancellor for Scientific Research

#### **College of Science**

51. Prof. Abdul Samee Al-Janabi Dean

### **Al-Mousel University**

52. Dr. Samim Al-Dabbagh Dean, Medical College, Acting President

#### **College of Electronics Engineering**

53. Dr. Bayez K. Al-Sulaifanie Dean

#### **College of Science**

54. Prof. Ihsan A. Mustafa Alabdalla Dean

#### **College of Computers & Mathematics Sciences**

55. Prof. Basil Younis Thanoon Dean

#### **College of Education**

56. Prof. Issam J. Sallomi Dean

#### **First College of Engineering**

57. Prof. Mohamad Tayed Al-layla Dean

#### **College of Agriculture and Forests**

58. Prof. Mowafak Mahmood Ahmed Dean

#### **Center of Remote Sensing**

59. Dr. Mohammed Younis Al-Alaf Director

#### **Scientific Research & R & D**

60. Dr. Mekdad R.A. Al-Juwari Director

### **Al-Basrah University**

61. Dr. Salman Dawod salman President

#### **College of Science**

62. Prof. Georgius A. Adam Prof. of Industrial Chemistry  
63. Dr. Athir M. Hadda Vice Dean for Administration and Students affairs  
64. Dr. Niran J. El-Salihi Assistant professor of Chemistry  
65. Dr. Ghazwan Faisal Fadhil Assistant professor of Chemistry

#### **College of Engineering**

66. Prof. Saleh E. Najim Dean  
67. Dr. Ameen Ahmed Al-Edani Dean Assistant for Scientific Affairs  
68. Dr. Abbas Hafeth Abbas Dean Assistant  
69. Prof Nabeel Abdurazzaq Jasim Head of Civil Engineering department  
70. Prof. Anis A. Mohamad Ali Professor of Civil Engineering  
71. Dr. Majid A. Alwan Head of Computer Engineering Dept.



### **Marine Science Center**

72. Dr. Malik H. Ali Director General

### **Salahaddin University**

73. Prof. Saadi Barzinji Chancellor  
74. Dr. Dara O. Meran Vice Chancellor  
75. Dr. Rostam Karim Saeed Dean, College of Science.

### **University of Sulaimani**

76. Dr. Kamal H. Khoshnaw President

### **University of Andar**

77. Dr. Adel N. Abid Dean, College of Engineering

### **Iraqi Center for Cancer and Medical Genetics**

78. Prof. Nahi Y. Yaseen Director General  
79. Dr. Shalal M. Hussian Vice Director

### **Psychological Research Center**

80. Dr. Al Harith A. Al-Asadi Dean  
81. Dr. Ghassan Hussain Salim Vice General Director for Scientific Affairs  
82. Dr. Mumtaz Hussien Muhammed Head of Studies and Research Dept.  
83. Mrs. Maysa Hssam Jaber Officer of Scientific Documentation Unit

### **Ministry of Industry & Minerals**

84. Eng. Muhammed Tawfiq Rahim Minister  
85. Mr. Taha I. Mohamed Director General

### **General Commission for Industrial Research and Development**

86. Dr. Mahdi H. Halim Director General  
87. Dr. Abdul-Jabbar N. Khalifa Senior Research Scientist  
88. Eng. Baha G. Ikzer Chief Engineer

### **Petrochemicals & Fertilizer s Research Center**

89. Dr. Mahmood M. Barbooti Director

### **Ibn Al-Bitar Research Center (for pharmaceuticals raw materials)**

90. Mr. Riyad M. Noman Director

### **Al-Rabee Agriculture & Food Research Center**

91. Dr. Faisal Rashid Nasir Director  
92. Dr. Mowaffak Said Naowm Head of Agriculture Dept.

### **Energy & Environmental Research Center**

93. Eng. Magid Hassan Ali Director

### **Veterinary Medicine Research Center**

94. Dr. Faris A. Habib Director

**Al-Razi Research Center** (for medical diagnostic instruments)

95. Dr. Ali Abdul Rahman Taha Director

**Ibn Sina Research Center** (for pharmaceuticals medicines )

96. Dr. Safaa Abid Lateef Director

**Construction and Glass Research Center**

97. Dr. Firas Faisal Abdul-Hameed Director

**Ministry of Agriculture**

98. Mr. Abdul Amir Al-Abood Minister  
99. Dr. Sawsan Ali Majed Senior Deputy  
100. Dr. Rafid A.K. Hussein D.G., General Company for Services of Animal Wealth  
101. Mr. Sadiq Jumaa Shaikh Ali D.G., General Company for Agricultural Supplies  
102. Dr. Hazim Abdul Aziz Mahmoud D.G., Agricultural Guidance & Cooperation Directorate  
103. Dr. Abdul Aziz A. Abdul Fatah D.G., Planning & Follow-up Directorate  
104. Eng. Sabri Shamoun Abdullllah D.G., General Commission For Agricultural Lands  
105. Dr. Aziz S. Jabur Al-Aubady D.G., Mesopotamia General Company For Seeds  
106. Prof. Zuhair Aziz Stephan D.G., General Commission for Agricultural Research  
107. Dr. Nazar Nouman Hama Vice D.G, General Commission for Agric. Research  
108. Dr. Mohsen Abdulnabi Hussan D.G., General Company for veterinary  
109. Dr. Zohair Taha Coordinator of Ministry Council  
110. Dr. Hameed M. J. Al Rady D.G., General Commission for Plant protection  
111. Dr. Abdulaziz Abdulrahman D.G., Planning & Follow-up, M.O. Agricultural  
112. Dr. Sabah Al-Kawwaz D.G., General Company for Forestry & Horticulture  
113. Dr. Salem M. Bader Deputy D.G., General Company for Forestry & Horticulture

**Iba'a Center for Agricultural Research**

114. Prof. Medhat M. Elshahookie President  
115. Dr. Raad Omar Salih Research Director

**Ministry of Science and Technology**

116. Dr. Rasahad Omer Mandan Minister  
117. Eng. Marouf M.S. Al-Chalabi Director General, Directorate of Planning & Follow-up  
118. Prof. Athab T. Al-Kinani Director General, Directorate of Medical Physics  
119. Dr. Khalil Al-Shakarchi Director General, Directorate of Physics Researches

- 120 Dr. Samir S.R. Al Attar  
121 Dr. Mohammed A. Habeeb  
122 Dr. Emad Soliman Shams Aldin

Director General, Directorate of  
Aerospace Tech.  
Directorate of Physics Researches  
Director of International Relations  
Office

### **Ministry of Planning**

- 123 Dr. Mehdi Al-Hafidh  
124 Prof. Hilal A. T. Al-Bayyati

Minister  
Professor of Mathematics

### **Ministry of Environment**

- 125 Dr. Ali Aziz

Advisor

### **Ministry of Water Resources**

- 126 Eng. Waleed Abdul Hamid Salih  
127 Dr. Wisam Salih

Director general, Planning and Follow-  
up Directorate  
Project manger

### **Communication sector**

- 128 Dr. Sahkir A. Abdulla

Senior expert in Iraqi communication  
sector

### **Ministry of Electricity**

- 129 Mr. Fawzi N. Jorani

Manager, Minister Office

### **Ministry of Health**

- 130 Dr. Ammar Al-Saffar

Deputy Minister

## **Appendix D: Structure of Iraqi Ministries**

### ***Ministry of Higher Education and Scientific Research:***

The ministry oversees twenty universities distributed geographically as follows:

Central Area: including Baghdad has the following universities:

1. Baghdad University
2. Al –Nahrain University
3. Mustansyria University
4. Technology university
5. Al-Anbar University
6. Diayala University
7. Wassit University
8. Islamic University

Northern Area: comprises six governorates and houses the following universities:

1. Mousl University
2. Erbil University
3. Sulaymaniyah University
4. Dohohok University
5. Tikrit University
6. Kirkuk University

Al Furat Al-Awast Area: houses the following universities:

1. Al-Kufa University
2. Al-Qadisia University
3. Karbola University
4. Babil University

Southern Area: houses the following universities:

1. Basrah University
2. Thi-Qar University

In addition, the ministry supervises eight private universities located mainly in Baghdad. The number of the specialization in these universities is directly related to the size, age and location. Most of the universities have graduate studies; diploma, MSc and PhD studies.

The Ministry also oversees all technical institutes through the commission of technical education in all technical fields. Many research and studies centers are attached to the universities or connected to the ministry directly. The most recognized are the:

- Psychological Research Center; and
- Cancer Research Center.

### ***Ministry of Science and Technology (MOST)***

The newly established organization for science and technology (S&T) was established in August 2003. This organization encompassed the dissolved Iraqi Atomic Energy Commission (IAEC) and several other R&D companies that were part of the Military Industry Commission (MIC).

Primary concerns of MOST are:

1. Science and Technology with immediate application to R&D.
2. Collaboration with scientists from other research centers including regional and international on fundamental and applied research.

Scientists, technicians, engineers and planners have been accommodated in MOST in the following Directorates:

1. Aerospace
2. Physics
3. Electronics and communication systems
4. Information Technology
5. Water technologies
6. Engineering projects
7. Material sciences
8. Hazardous material and environment
9. Agriculture.

### ***Research and Development in the Ministries***

The public sector in Iraq in the fields of industry, energy, agriculture, trade and public services have contributed to the economy of the country since early sixties. For example the Ministry of Industry developed glass, drug and cement factories and the Ministry of Health funded cardiology and cancer centers. It continued to extend its valuable activity so that it encompassed a large number of important commissions companies and research centers. Examples of Research Center's are:

- Agriculture Research Center in the Ministry of Agriculture
- Water Research Center in the Ministry of Water Resources
- Research and Development Establishment in the Ministry of Industry and Minerals
- Environment Research Center in the Ministry of Environment.

### ***The Academy of Sciences***

As a national academy, the Academy of Sciences was established in 1978. It used to be the main entity that hosts prominent Iraqi scholars in all fields of science and literature. It was established as an independent entity attached to the Iraqi Presidency. Historically, the institution cares for the Arabic language and Iraqi Heritage. However, the Academy has one main objective is "To promote scientific studies and research in Iraq to keep up with scientific progress in the world". Specific S&T operations of the Academy are: compiling technical S&T terms, encourage and promote authorship and research and strengthen ties with international academies of science. The Department of Pure and Applied Sciences is one of five departments that constitute the Academy.

## Appendix E: List of Project Ideas

The final number of evaluated projects received form wide spectrum of Iraqi scientists, researchers and technologists.

### Health

1	Develop research in tissue culture
2	Applications of laser engineering in medicine
3	Psychological research into the severe stress of the Iraqi community
4	Production of pharmaceutical & chemical products
5	Develop the applications of Cardiac Electro physiology
6	Research for neurological diseases
7	Medical plants research
8	Procedures for early diagnosis of cancer diseases
9	Development and applications of medical therapy in cancer treatment
10	The role of environmental pollution in spreading cancer diseases among Iraqi population
11	Establishment of cancer cell lines
12	Industrial production and Gypsum bandages for bone fixation
13	Project of active compounds in the medical plants
14	Production of chloroxyleneol and derivatives as detergents (reactive materials, solutions, cream, soaps)
15	Prevalence of diabetes in Iraqi population and it's related risk factors
16	Research for biomedical engineering for cardiovascular diseases
17	Bladder cancer research
18	Muscle disease diagnosis
19	Extension of facilities for laboratory animals
20	Diagnosis and treatment of blood disease with special interest on Leukemia
21	Cytogenetic study on newly born malformed infants
22	Reducing the radiation dose and risk to patient and staff using diagnostic X-rays by implemented quality control (QC) program
23	Correlation between pulmonary TB and Pneumoconiosis infection
24	Occurrence of TB infection in Basra

## Biotech and Genetics

1	Synthesis and polymerization of carbohydrate derivatives and modification of carbohydrate polymers as an active polymer capable to biodegradation and chemical degradation
2	Synthesis of nucleoside and nucleotide analogues as chemotherapeutic agents
3	Production of biodegradable polymers, IPNs for surgical uses (bone fixation semi permeable bandages, hydro gel (sand bags) and controlled release drugs as hydro gel for local treatment
4	Synthesis and evaluation of controlled release drugs based on polymers and polymeric IPNs
5	Production of reactive materials as anti cancer drugs for drug industries
6	Biological therapy trial for cancer by using avian viruses
7	Extraction of mitotic substances from Iraqi local flora
8	Synthesis of mono antibodies
9	Utilizing plant tissue culture technique in Increasing and producing medical active compounds in some Iraqi medical plants
10	Isolation, preservation and culturing stem cells from umbilical cord and the placenta of humans in treating blood diseases in Iraq
11	Assisted reproduction technique (ART) and in vitro fertilization (IVF)
12	Epidemiological Study and diagnostic study of Capillaria-hepatica
13	Synthesis and QSAR of bioactive molecules
14	Drugs and therapeutic extracts obtained from animal and plant sources or compounds
15	Production of Hydrogen from bacteria

## Veterinary and Live stock

1	Performance improvement of large ruminants (cows & buffalos) in IRAQ
2	Genetic improvement of local sheep and goat types for meat production
3	Poultry production of original stock for broilers & layers production
4	Establishing an artificial insemination hatchery for sea and fresh fishes
5	Uranium and radium in phosphate fertilizers and livestock feed supplements and their potential hazard
6	Farms for Culturing chlorella Alga and Artemia crustacean

## Agriculture

1	Application of information technology and communication in strengthening cooperation between research technology, extension and farmers
2	Development of integrated pest management program in the orchards of IRAQ
3	Seed improvement program of main crops suitable for IRAQI environment
4	Development of potato production crop in IRAQ



5	Application of biotechnology & genetic engineering technologies on date palms productions
6	Developing of productivity of salinity soils using complete technical package technology & formulations
7	Application of saline water in irrigation
8	Organic fertilizers application project
9	Establishment of toxicology laboratories
10	Production plant to produce equilibrium fertilizers and their derivatives
11	Production of industrial plants
12	Development of date palms sector, processing and packing of the dates and its products
13	Development researches for Aljazeera irrigation projects, by using remote sensing techniques
14	Studies for Developing the irrigation means in Iraq

### **Water resources**

1	Desalination of ground water in Iraq
2	Artificial recharge of ground water from Excessive water resources
3	Comprehensive environmental monitoring program of the surface water resources
4	Snow accumulation on northern mountains monitoring program
5	Hydro geological mapping of underground water
6	The impact of the main drainage canal (the third river) on agriculture economy
7	Weed control in Irrigation and drainage networks and rivers
8	Basin, dam and reservoir of Al-Mousel
9	Hydro geological investigation of the southern region of Iraq
10	Production and evaluation of electro-dialysis system suitable to deal with Iraqi water

### **Environment**

1	Screening of food, water, soil and air for radioactive bio-chemical hazards
2	Food and plant surveillance monitoring and control caused by irradiation
3	Strengthening the general environment situation
4	Monitoring environmental pollution in the watercourses in Basrah
5	Conducting environmental studies and researches to control the environmental pollution of some factories and workshops
6	Gamma project for sterilization
7	Decontamination of land building and environment from depleted uranium (D.U)
8	Technology transfer for water and sewage treatment
9	Utilizing low cost biological engineering techniques for treating sewage water

10	Studying the environmental and radioactive pollution in Iraq, and the ways of treating and controlling their biological impacts
11	Improving the quality of purified water in Iraq
12	Rehabilitation and vitalization of the Marshes to create a sustainable haven for man and nature, and to boost the country's economy
13	Food pollution by fungal toxins and its impact on humans and animal health
14	Oil degradation by microorganisms
15	Pollution tracing of underground water

### **Energy and Electricity**

1	Development and deployment of alternative energy sources
2	A group of projects to generate electricity from renewable energy
3	Using water resources in Iraq in electricity generation
4	Estimation & modeling of load and planning of electricity generation for the national grid
5	Using the artificial lakes instead of rivers for cooling purposes in power generation plants
6	Design, Building of a field balancing computerized system

### **Information Technology**

1	Digital dictionary & encyclopedia (A/E)
2	Electronic and IT training
3	Create National University/college of information technology
4	Software House
5	Virtual Digital Library
6	Urgent assistant to the Ministry of Labor and Social Affairs.(Capacity Building Support )
7	Design and implementation a social welfare management information system (MIS) in Iraq (SWMIS )
8	Intellectual control for robotic applications.

### **Communication**

1	Studying the communication and satellite systems (GPS) and their effect on humans and buildings
2	Many research projects in satellite engineering to contribute to the reconstruction of communication sector
3	Optical/Laser research
4	Wireless Local Loop (WLL)
5	Rehabilitation of the telecom training institute of ITPC

6	IP based VSAT system to connect Iraqi Universities
7	GIS Project

### Engineering

1	An engineering expert system for Gypseous soils in Iraq
2	Development and improvement of the performance of the quality assurance and consultation services in the thermal sector
3	Evaluate, maintain and strengthen the structure of available buildings in Iraq
4	Geo-chemical and Geo-technical properties of contaminated and treated limestone from the phosphate complex in Iraq
5	Low cost housing projects
6	Documenting the Iraqi architecture and protecting the Iraqi heritage
7	Design and manufacturing of fully programmable machine for floor coating with polyethylene and other polyolefin as a new anticorrosion technique
8	Industrial production for refractories
9	Production of biocides for cooling towers.
10	Synthesis of corrosion inhibitors
11	Production of Lignosulfonate.
12	Cation exchange resin
13	Preparation of drugs
14	Some environmental and economical effects of using metal working fluids
15	Production plant to produce emulsion system of industrial importance
16	Islamic tourism in Iraq
17	Design rules of the suitable construction for the Iraqi climate
18	Computer aided design and evaluation of a system for construction and industrialization of a multi-stages cutting dies
19	Dealing study for the design and development of thin plummet wind turbine
20	Utilization of Shlern's imaging method to study a gas-air mixture fuel flam distribution
21	Produce and develop chemicals for petrochemical industries
22	Optimization of ammonia-water absorption system

### Materials

1	Production for polyamines and their derivatives
2	New technology for production of Resole Novolak Resin
3	Production for active polyethylene, Inter-penetrating Polymer Networks (IPNs), and composites
4	Production of epoxy Resin of different types by new technologies

5	Production of industrial reactive chemicals
6	Synthesis and evaluation of bio degradable polymers based on carbohydrate derivatives
7	Production of furfural oil from corn residue
8	Advanced research for ceramics and nano-ceramics material
9	Evaluation of valuable metals in general and the Aluminates metal in particular, and the possibility of extraction Titanium dioxide in the sand units specially selected from Iraq and the Gulf Co-operation Countries (GCC)
10	Elements extraction form raw material and industrial waste
11	Production of refractory bricks from local raw materials
12	Study of manufacturing Aluminum-copper straight joint connections for high voltage lines
13	Generating electricity by thin films solar cell

### **Basic Sciences**

1	Research for astronomy, space and remote sensing sciences.
2	Cloud seeding and rain enhancement project
3	Meteorological Message Switching System (MMSS)
4	Limited area meteorological numerical prediction model
5	Monitoring the occurring variations in the sea level of the Iraqi coast
6	Remote detection of hydrocarbon micro seepages in selected regions in southern Iraq
7	Chlorine and other polymer additives impregnated on low density polyethylene (LDPE)- wax
8	Correlation analysis (organic compounds)
9	Isolation of pigments
10	Recycling of waste Ion exchange resins for other industrial applications

## **About the Arab Science and Technology Foundation**

The Arab Science and Technology Foundation (ASTF) is an independent, nongovernmental, non-profit regional and international organization based in Sharjah, UAE. ASTF aims to identify and support outstanding scientific research activities being conducted by women and men of science and technology from the Arab world. It also attempts to act as a mediator between those who produce, develop, finance or benefit from scientific research, while seeking to become a center for assessing the performance of scientific programs and also a powerful international Arab entity that defends the region's interests in scientific and technological progress.

ASTF was founded upon a recommendation from the symposium on "Scientific Research Out in the Arab world and the New Millennium: Science and Technology" organized by the University of Sharjah in April 2000. Its establishment was declared in the closing session of the Symposium upon the initiative of His Highness Sheikh Dr. Sultan Bin Mohaammed Al-Quassimi, Member of the Supreme Council of the UAE, Ruler of Sharjah. The ASTF board of directors is composed of an elite cluster of renowned Arab scientists, and its members inhabit a continuous geographic area stretching from the northern coasts of Africa on the Atlantic and across the Eastern Mediterranean to the coasts of the Arabian Peninsula on the Arabian Gulf.

ASTF is the first organization to bring together scientists from inside and outside the Arab world with the aim of utilizing local and expatriate expertise in service to the Arab world and humanity in general. For more information about ASTF programs see: <http://www.astf.net>

## **About the Cooperative Monitoring Center**

The Cooperative Monitoring Center (CMC) enables international technical cooperation on strategic issues such as nonproliferation, combating terrorism, nuclear and bio-security, and environmental stability. The CMC is located at Sandia National Laboratories in Albuquerque, New Mexico and is primarily funded by the United States Department of Energy National Nuclear Security Administration.

Representatives from over 80 countries have participated in CMC sponsored activities such as workshops, seminars and the visiting scholars programs. Focused efforts have addressed particular security issues in the Middle East, South Asia, East Asia, Central Asia, Russia and China.

The CMC Visiting Scholars Program brings experts from countries such as India, Pakistan, China, Israel, Russia, and Jordan to work with technical experts at the CMC to explore how technology can support the development and implementation of security policy and agreements. The CMC has a Technology Training and Demonstration (TTD) area which provide hands-on experience with exportable technologies and systems used for nonproliferation, arms control, nuclear material security, border security, biosecurity and other security challenges. Customized and standard training courses are available. Additionally, laboratory and system test facilities are available to support international training and technical collaborations. The Outdoor Test Facility has been developed specifically to support a wide range of border security applications.

For more information, visit the CMC website at: <http://www.cmc.sandia.gov>

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