9. Pakistan Council of Scientific & Research (PCSIR)

While reviewing recommendations of the Prime Minister's Inspection Commission in respect of Pakistan Council of Scientific & Industrial Research (PCSIR), the Prime Minister was pleased to direct that Ministry of Science & Technology shall develop a comprehensive Action Plan to improve effectiveness of the organization, in consultation with the Adviser to PM on Institutional Reforms & Austerity. In this regard, Ministry of Science & Technology developed a Action Plan, which is at Annex 1. The Adviser to PM on Institutional Reforms, on reviewing the document, proposed the following additional agenda of reforms to PM on 10th February 2021 in order to meaningfully restructure the organization.

Recommendations

1. At the outset, PCSIR was established in 1953 to innovate and modernize the industrial processes and products through research, so as to substitute the imports and bring value addition to the exported products and thus contribute to economic progress of country. In the present times, this original mandate is but ever most significant and relevant. However, over the period of time, focus has been shifted from solutions-oriented research to providing testing services, trainings and diplomas etc. The situation needs a major course correction.

2. To this end, **establishment of Advisory Committee** (as proposed in draft plan by Ministry of Science & Technology) is supported. However, such a Committee should be established directly under the Ministry. The Committee should review, prioritize and spearhead the overall process of applied research and development in the country. Such advisory body may include eminent scientists, industrialists and policy makers and will be responsible for directing the research towards development of processes, products and services required for innovating industry and exports. The proposed Advisory Body will also ensure that existing research facilities available in public sector are optimally utilized, by doing away with the duplication/overlapping and bringing about overall coherence. Mandate for PCSIR will also be monitored, updated and guided by this Advisory Committee.

3. The existing composition of the Council is quite large (21 members) and needs to be curtailed to a manageable number. To make PCSIR an autonomous body implementing the given mandate, it should have a **Board of Directors** comprising 8-10 members headed by a Chairman. Chief Executive of the PCSIR will be a Director General reporting to the Board and assisted by a **Management Council** and **Research Council** consisting of leading scientists from within and outside the organization. The proposed governance structure and suggested research themes is annexed. In order to achieve this, suitable amendment in PCSIR Act 1973 are required.

4. PCSIR has a sanctioned strength of 2762 employees with an annual recurring budget of Rs.3 billion. Approximately 43% of the sanctioned strength comprises non-technical staff. This ratio is quite high and a total freeze on recruitment of non-technical posts should be imposed. The posts becoming vacant should be abolished forthwith. The savings thus effected should be utilized for performance-based output of scientists and technical staff. Performance Appraisal Boards should be established reporting directly to the Direct General. These outputs would be, for example, commercialization of patents, research outputs and advisory services the industry etc. The proposed Action Plan has made some suggestions for **rationalization of human resource** and quality improvements, which may be substantiated with these additional measures:

   i) The organization should immediately shift from the funded pension system. Rules should be amended so that new employees are subjected to defined contributory pension scheme.

ii) The new research proposals should be carried out in project mode. In addition to regular staff, outside scientists should be hired from within and outside the country on market-based remunerations but purely for the tenure of project cycle. Top performers should be rewarded with bonuses and should be considered for retention in next cycle of products (testing, upscaling etc.) which should again be undertaken in project-mode. This scheme is closely linked with improving marketability of patented products/process (described below).
iii) The ratio of non-technical staff should be gradually lowered. For this purpose, the existing staff should be re-employed into the newly proposed projects. During our meetings with Chairman PCSIR, possibility was discussed that a large proportion of non-technical employees could be re-employed in laboratories as technicians with marginal training.

5. **Developing civil-military interface for better leverage of available R&D facilities** is a very appreciable step. Scope of such activities needs be broadened to include other institutions both in civil and military setups. In fact, PCSIR should develop and maintain an interface with other research facilities as a part of action plan. To quote the example, a number of projects and activities proposed in the attached Action Plan relate to genetic-engineering, upscaling the new strains, developing plant and animal products, and establishing bio facilities. It may be noted that Pakistan Agriculture Research Council (PARC) under the Ministry of National Food Security & Research is also undertaking similar activities. By close collaboration and coordination, both Councils may develop synergies through better utilization of existing knowledge-base and research facilities.

6. In order to **boost the revenue streams and promote self-sufficiency**, PCSIR needs to increase the marketing and commerciality of its research outputs. The given Action Plan envisages increased linkages with the industry in general and SMEs in particular through direct outreach. Such continued interactions are very important to keep the core research activities aligned to market needs. However, marketing and deployment of developed solutions needs separate skills set and should be kept separate from the core scientific and technical activities of the Council. Commercial interface of PCSIR with industry and SMEs should be through a separate and specialized subsidiary (Company) for all research institutions. Ministry of Science & Technology may also consider putting STADEC to better use for this purpose, which was established as a separate company with similar mandate. The company can not only directly market the patented technologies, but also develop framework for entering into joint ventures with private sector in order to mobilize resources even at conception stage of the projects.

7. The **future course of action** is suggested as under:

i) Ministry of Science & Technology may enter into an agreement with PCSIR on implementation of the proposed Action Plan along with above made observations/suggestions, with timelines and milestones.
ii) PCSIR may develop a detailed business plan stipulating the quarter-wise activities, targets and revenue projections in the light of finalized Action Plan, and
iii) Cabinet Committee on Institutional Reforms (CCIR) may review the progress on implementation of finalized plan every quarter with a view to approving any roll-on adjustments if required.

Decision

8. The above plan was shared with the Office of the Prime Minister on 10th February 2021. The Prime Minister directed the Ministry of Science & Technology to consider and incorporate the recommendations and suggested course of action to finalize the Action Plan. The Ministry

was further directed to elaborate and revise the timelines as per actual timeframe and re-submit the case for the order of the Prime Minister.

Current Status

9. Further action is to be taken by the Ministry of Science & Technology.\

Annex 1

1. Executive Summary

The Prime Minister's Inspection Commission (PMIC) carried out the study of the impact of the research organizations of the Federal Government including Pakistan Council of Scientific and Industrial Research (PCSIR). During the inspection, PCSIR provide data/ information as and when required by the PMIC from June, 2019 to January, 2020. In February, 2020, PMIC submitted its findings/ report. As per recommendation of the report, PCSIR submitted an Action Plan for improving the effectiveness of PCSIR in November, 2020.

The Action Plan includes interaction with S&T institutions within the country and abroad for technology transfer/ absorption in emerging and new technologies. Priority areas where PCSIR would like to excel in areas like leather, textile, food, herbal, automobiles/ transportation, engineering, nano technology, housing & public works, health, etc. PCSIR has planned to enhance R&D collaboration with military organizations and to execute demand-driven R&D projects evaluated and recommended by a high-level Advisory Committee at Head Office. Moreover, Establishment of Endowment Fund for Scientific and Industrial Research, Innovation and Commercialization (EFSIRIC) is also in pipeline to fund different scientific activities including the funding of joint venture under international cooperation.

Improvement in infrastructure and engagement of manpower for research in new fields e.g. halal certification, industrial/ medicinal cannabis, gene editing, biosensors, etc. will also be carried out. Furthermore, to increase the number of technical services, the scope of accreditation will be extended with new parameters i.e. cement, halal foods, food grade packaging materials, rapid testing of SPS organisms, calibration, etc. Efforts will also be made to strengthen the linkages with academia and industry to facilitate the clients. In addition, marketing cell will be strengthened for commercializing processes, products and technologies. Establishment of an international liaison centre at Head Office is also under consideration to enhance the international collaboration.

Inter-alia, PCSIR has prepared several project proposals in emerging scientific fields as per government priorities. These projects will not only up-grade the existing laboratories of PCSIR with latest techniques and state-of-the-art equipment but will also create opportunities in areas such as halal certification, cannabis cultivation/ processing for industrial/ medicinal uses and gene editing to enhance crops yield, etc. This investment will increase the number of industrial services and revenue generated by PCSR manifolds.

2. Introduction of PCSIR

The Government of Pakistan established Pakistan Council of Scientific & Industrial Research (PCSIR) in 1953 as an autonomous body to build a strong scientific and technological base for the economic progress of the country with mandate to undertake, promote and guide scientific and technological research related to problems connected with the establishment and development of Pakistani industries and disseminate the results of research to various sectors of the economic development community in the best possible manner.

2.1. MANDATE OF PCSIR

- Utilization of indigenous resources for the development and promotion of Industrial sector leading to import substitution and export enhancement.

- To carry out self-sustaining and marketable research to contribute in the industrialization and economic growth of country and human resource development through organized training courses**.**

2.2. ORGANIZATIONAL STRUCTURE OF PCSIR

The Chairman is the Chief Executive Officer (CEO) of PCSIR. The Council consists of 21 members including the Chairman. The Federal Government nominates 21 members. As per PCSIR Act No.XXX 1973, the composition of the Council comprises of the ex-officio members and the representatives of the public/ private sectors. The Council is the supreme policy-making body. The executive organ of the Council is the Governing body which consists of four members; The Chairman and the Members for Finance, Science and Technology. Under the above set-up various laboratories and centers functions under the Directors General or Directors.

2.3. LABS/ UNITS OF PCSIR

PCSIR is the premier public sector R&D organization of the country with a network of 17 research laboratories/ units including 06 training institutes located all over the country. PCSIR laboratories are ISO-17025 accredited equipped with state-of-the-art laboratory equipment and highly skilled manpower. PCSIR supports the local industries in various sectors for providing cost-effective technology solutions as well as quality assurance services.

2.4. MAIN ACTIVITIES OF PCSIR

The broad-based activities of the PCSIR include technology development, human resource development, quality control/ quality assurance services, consultancy/ trouble shooting and industrial linkages/ WTO obligations. The council laboratories are providing testing & certification services to almost entire industrial sector and most of the exportable products are being tested/ certified by its ISO-17025 accredited labs. Current major activities also include:

- Supply of strategic chemicals to the Defense sector as per their demand.
- Supply of indelible ink vials and stamp pads to the Election Commission of Pakistan (ECP) from time to time.

2.5. THRUST AREAS

The thrust areas of PCSIR touch almost all sector of the economy including Engineering, Food & Allied Products, Pharmaceuticals, Leather and Leather Auxiliaries, Textile & Associated Products, Glass & Ceramics, Biotechnology, Strategic Industry, Environment, Electronics, Industrial Chemicals, Paper & Plastic/ Polymers, Pesticides & Herbicides, Oil & Fats and Dyes.

Technical training centers of PCSIR at Karachi, Lahore, Peshawar, Quetta and Daska are providing 3-4 years diploma certificates in Cast Metal & Foundry Technology, Dye & Moulds and Precision Systems Mechanics and Bachelor degree in Industrial Electronics Engineering. More than 300 students are awarded diplomas/ degrees annually and most of them get jobs immediately.

2.6. STRENGTHS OF PCSIR

- Qualified scientific & technical manpower (Ph.Ds., M.S./ M.Phil, M.Sc./ B.E. etc.) to undertake R&D activities.

- Expertise to develop small to medium-scale processes, procedures and technologies in diversified areas of Research & Development.
- Competence to undertake quality control and standardization of industrial products and unit operations.
- Availability of Pilot Plants for testing of developed technologies.
- Workshops Facilities for Design & Development of equipments, plants, tools & parts.
- Expertise of trouble-shooting and repair/ maintenance of equipments.
- Expertise to extend consultancy services and undertake feasibility studies.
- Recognition of PCSIR by International & National Organizations:-
  - ISO/ IEC 17025:2005 Accreditation by PNAC (Since 2005)
  - ISO/IEC 17025:2005 Accreditation by Norwegian Accreditation (2007-2010)
  - Saudi Arabian Standard Organization (Approved Lab.)
  - Ministry of Health & Welfare Japan (Approved Lab.)
  - Agency for Agriculture Quarantine, Ministry of Agriculture, Republic of Indonesia (Approved Lab.)
- More than 550 accredited tests/ calibration services of PCSIR

3. Inspection by the PM's Commission

The Prime Minister's Inspection Commission (PMIC) carried out the study of the impact of the research organizations of the Federal Government including Pakistan Council of Scientific and Industrial Research (PCSIR). During the inspection, PCSIR provide data/ information as and when required by the PMIC from June, 2019 to January, 2020. In February, 2020, PMIC submitted its findings/ report. As per recommendation of the report, PCSIR submitted an Action Plan for improving the effectiveness of PCSIR in November, 2020. (Timeline of the plan is given at 3.1).

3.1. ACTION PLAN

Timeline for Implementation

Milestones	Estimated Time (Month)					
	Dec-2020	Jan-2021	Feb-2021	Mar-2021	Apr-2021	May-2021
Conduct & Discipline Rules	6 months					
Flow of Funds to Units	4 months					
Council Meetings	4 months					
Revised Amended Act of PCSIR	1 month					
Constitution of Advisory Committee	4 month					
Implementation of KPIs	2 months					
Increase in Scope of Accreditation	3 months					
Rationalization of Manpower	4 months					
Commercialization of PCSIR Products	5 months					
Industrial Services	4 months					
Human Resource Development	3 months					
Development of Business Plan	6 months					
Enhancement in International Cooperation	4 months					
Setting-Up Merit-Based Criteria	2 months					

4. Human Resources Development

4.1. PRESENT WORKING STRENGTH

At present, 2066 employees (Technical/ Non-technical) are working in PCSIR against the sanctioned strength of 2762 out of which, 420 Nos. (BS-17 & above) are on Technical side (Technical Sanctioned Strength: 622 Nos.) in which 114 Nos. are having Ph.D. qualification. These scientists/ engineers/ technologists are supported by 690 Nos. (BS-1 to BS-16) of technical staff (Technical Sanctioned strength of supporting staff: 950). There are 896 Nos. of non-technical employees (officers/ officials) presently working in PCSIR against the sanctioned strength of 1190 employees (non-technical side).

4.2. GENERAL GAPS IN HUMAN RESOURCE

- The organization is facing an acute shortfall of trained manpower as no induction has been carried out since 2012. Brain-drain for lucrative jobs/ better future prospects and gradual retirements of senior cadre staffs with the passage of time has caused adverse implications for the overall productivity of PCSIR.

- The employees (scientists and researchers) and other supporting staff find it hard to cover the living expenses in meager salaries which hamper their concentration and dedication.

- Unfortunately, in Pakistan, drivers and junior staff in some departments earn higher salaries than qualified (PhD, Officer Cadre) scientists who dedicate half of their lives in studies, specializing in their relevant subject of interest.

- Promotion criterion is old and depends totally on seniority and does not consider skills and performance which discourages good performing scientists/ workers.

- Incompetence and permanent job syndrome most of the time force the head of the units to approach active scientists directly bypassing their HOC/OICs or section in-charges.

- PCSIR, Labs are mostly engaged in Commercial Quality Testing of Industrial Samples (Analytical Testing services) than R&D. Though, the impact of these services is great in terms of export of consumer goods, but on other side it lowers down the research activity of the Scientists. Moreover, analytical testing services are excessively demanding and it’s consuming the major part of human resource energy and effort.

- Nothing is allocated for trainings and capacity building of scientists/ technologists. Even the procedures to pursue self supported trainings are too complicated. Procedures should be made easy to facilitate scientists/ technologist. Funds should be allocated to participate in local and foreign trainings.

4.3. FUTURE STRATEGY

- Rationalization and reshuffling of manpower will be considered. Workload analysis will be carried out for making an appropriate decision for underutilized and low performing employees. Moreover, the proportion of scientists to non-technical staff or the ratio of laboratory staff to non-technical staff will be reviewed.

- Benchmarks will be set across the board for all Scientists/ Engineers/ Technologists with a specific timeline and future promotions and other incentives will be awarded strictly on merit/ meeting of benchmarks.

- The activities will be segregated at least into two categories; Analytical Commercial Testing and R&D to get some productive results.

- Performance based incentives programme is being introduced to encourage and motivate the hardworking R&D Staff and improve the overall productivity of the Organization.

- Responsibilities will be given to scientists whether it is client enquiries, report preparation, purchase, ISO management, Industrial visits and the list goes on.

- Collaboration with the Federal/ Provincial Vocational Training Authorities shall be enhanced to meet the demand of local industry.

- HEC will be requested to coordinate with the industrial sectors and announce/ plan topics related to Marketable Research for Ph. D and Postdoctoral studies.

- Provide training to the local community of Gilgit-Baltistan with skills/ techniques for preservation of fruits and vegetables and value addition.

- Funds will be requested from MoST for the most advanced trainings of PCSIR scientists/ engineers as per the demand of the market be arranged to keep the knowledge based of the R&D staff highly sophisticated and innovative.

- Implementation of KPIs for Scientists/ Engineers: To enhance the performance of different units of PCSIR, Key Performance Indicators (KPIs) have already been prepared and implemented. KPIs for each scientist/ engineer with targets have also been prepared and will be implemented in all units/ labs by January, 2021 (02 months).

5. Budget of PCSIR

The table below presents the development and non-development budgets of PCSIR from 2016-17 to 2020-21 (last five years).

Year	Budget Allocation (millions)	
	Non-Development	Development
2016-17	2183.841	550.817
2017-18	2312.961	186.477
2018-19	2707.582	730.309
2019-20	2716.908	336.659
2020-21	3119.237	421.541

5.1. FINANCIAL CONSTRAINTS

- One of the reasons for Pakistan to lag behind in spending on R&D and Innovation is the reluctance of the government to allocate sufficient financial resources. Furthermore, amongst the allocated budget, the lion's share goes to in the salaries and pensions and only a meager amount is spent on actual R&D.

- Lack of financial support is the major issue along with the misallocation of facilities and human resource. Some of the labs are well equipped, but trained manpower is not there. On the other hand, some of the active scientists are willing to work, but they are not provided with their required equipments and consumables.

- Lack of national funded scholarship programs for training of scientists creates huge gap between Pakistani scientists and the rest of the world.

- No funds are provided/ allocated for scientists to participate in foreign trainings, seminars, workshops, etc.

- No funds are provided/ allocated to execute the agreements/ MoUs with the international organizations.

5.2. FUTURE STRATEGY

- Introduction of Incentive Award scheme for performing scientists/ engineers.

- Funds will be requested from MoST for the most advanced trainings of PCSIR scientists/ engineers as per the demand of the market be arranged to keep the knowledge based of the R&D staff highly sophisticated and innovative.

- Funds will be requested from MoST for the execution of international MoUs/ agreements. .

- Smooth Flow of Funds to the Labs/ Units: Governing Body of PCSIR in its meeting held on 23-01-2020 has recommended to enhance the administrative approval for in-house R&D projects/ activities at PCSIR Labs./ Centers up to one million per project subject to amendments in Clause-C of Rule 6 of Financial Rules of PCSIR and approval from Council. The Council meeting is planned in February/ March, 2020. This task is expected to be completed in March, 2021 (04 months).

Strategy Outlook

5.3. CIVIL MILITARY R&D FRAMEWORK

I) Smart digital automation, control and indigenization of second generation feedstock and end products

It is of prime importance to create a sustainable capacity & capability in public sector R&D and related facilities for continuous innovation in the area of metabolic engineering, sugar production technology and high-value bioproducts. This pilot project envisages introducing a Sugar Production Biotechnology Infrastructure Platform on pilot scale. There are two components to this pilot project, which are briefly described as follows:

a. 2nd Generation Sugar Production Technology Platform Development - PAEC

b. Fourth Generation Cellulosic based High-value Bioproducts Production - PCSIR

The production of second generation bioethanol requires saccharification of lignocellulosic materials followed by fermentation of the released sugars to ethanol by microorganisms. Besides bioenthanol, other high-value bioproducts that could be included are highly refined DHA omega-3 oils, terpenoid compounds, carotenoids, etc. using strain engineering.

II) Development of Computer Controlled Fermentors and Production of Biochemicals & Bioproducts

The project focuses on manufacturing fermentors and microbial strains, bioproducts and biochemicals. Fermentors are extensively used for food processing, fermentation, waste treatment, etc. Modern fermentors are usually integrated with computers for efficient process monitoring, data acquisition, etc. PAEC's expertise in automation and engineering coupled with PCSIR's understanding of industrial processes can create an opportunity to establish an indigenous design and manufacturing footprint for reliable and scalable fermentors suitable for production of various microbial strains and subsequent high value biochemicals, biopharmaceuticals, biofertilizers, biopesticides, etc..

The pilot project has two components, which are briefly described as follows:

a. Computer-Controlled Fermentor (Bioreactor) Development - PAEC

b. Pilot Scale Manufacturing of Microbial Strains, Biochemicals & Bioproducts - PCSIR

III) Endowment Fund for Scientific and Industrial Research, Innovation and Commercialization (EFSIRIC)

The proposed endowment fund is envisaged to be established and operated by PCSIR with initial capital to be provided through PSDP. This fund would then be invested into secure investment schemes. The return on the investment (ROI) will be then utilized for purposes such as advanced R&D activities, pilot industrial projects, commercialization and marketing activities, research-industrial linkages, etc. The ROI will promote the development of socio-economic innovation in Pakistan in the areas of science and engineering (R&D) and other enabling technological areas. Pakistan is blessed with brilliant youth which can play pivotal role in the 4^{th} industrial revolution by proper harnessing them through this endowment fund. Pakistan has a youth bulge and more than 65% are less than the age of 35 years which has huge potential for technological revolution. This talent needs direction plus financial support to bring the change and this fund (ROI) will help also in putting stop to brain drain.

The income from invested capital will help in establishing an indigenous innovation base and expertise in emerging technologies with commercial business potential. Thus, the endowment fund will provide essential link for creating a complete ecosystem from scientific research to developing industrial products and commercial level scale-up. In the current knowledge-driven society, enriching a vibrant innovative ecosystem that will play a key role for economic development. The ultimate result will be the economy boost in the country.

The initial/ seed capital will be put into secure investment schemes that could yield high profits on monthly basis. The income generated through investment will then be utilized for:

a) advanced R&D activities,

b) pilot industrial projects, entrepreneurship

c) commercialization and marketing activities,

d) research-industrial linkages, etc

The Governing Body of PCSIR will oversee/ manage and steer the Endowment Fund. To assist and advise the Governing Body, a Steering Committee will be constituted as follows:

a) all four members of the Governing Body of PCSIR,

b) three co-opted members:

i. DG NECOP

ii. one from industry

iii. one civil-military representative.

Chairman, PCSIR will be the chair of the Steering Committee. This committee will also be responsible for policy recommendations for effective governance and implementation.

5.4. FOCUSING ON SMALL & MEDIUM ENTERPRISES (SMEs)

Emphasis will be given, initially, on PCSIR's available Core Competencies, while expanding reach or finding suitable private sector partners for the products that have been developed or are under development. The listed below strategy will be adopted:

Leasing out of Technologies/ Products:

The present Core Competence/ Strengths are sufficient indicators for PCSIR to embark upon various innovative technologies for commercialization. Among these are the mobilization of venture and risk-capital by SMEs. However, given below impediments have to be considered which are being faced by PCSIR:-

- SMEs are reluctant to invest in untested technologies.
- Venture capital is not available.
- Risk factors are too high for SMEs.
- Capital costs for development of industrial operations is prohibitive for SMEs.
- Import of technologies is easy.

The proposed mechanism of commercialization of technologies through TBICs will have the following salient features:-

a) PCSIR will demonstrate viability of the developed technologies on pilot plants to prospective SMEs.

b) After successful demonstration, SMEs will be encouraged to develop a partnership with PCSIR:-

- At the technical facilities of PCSIR.
- Under the supervision of PCSIR experts.

- Cost of raw materials to be paid by SMEs.
- Cost of building utilization charges, utilities etc. to be paid by SMEs.
- Marketing potential to be explored by SMEs.

c) Graduating technologies to be industrialized by the SMEs within 6- 12 months.

d) PCSIR to continue providing technical support for quality control, Intellectual Property (IP) rights etc. of the products.

e) Products to be marketed with logo/ trademarks of PCSIR/ SMEs.

Furthermore, the following measures could also boost the technology commercialization in PCSIR:-

- Incentivize policy to introduce demand driven R&D culture with inclusion of equity from private sector & its commercialization to identified industry.

Quality Assurance/ Quality Control Services:

One of the major strength of PCSIR is having nation-wide state-of-the-art R&D facilities in provincial capitals as well as in federal capital to evaluate and test raw materials, finished products and calibration services in accordance with international standards. Although several public & private sector laboratories are available for conducting test/ analysis but PCSIR is considered to be a reliable & reputable organization both at National & International level and stands alone in the country having more than 550 tests/ calibrations services accredited through Pakistan National Accreditation Council (PNAC).

Keeping in view the above-narrated strengths, efforts will be made to expand the reach of testing (including increase in accreditation scope) as well as to declare PCSIR Laboratories as National Quality Control Labs. as 3rd Party Evaluation for PS (Pakistan Standards) mandatory items.

PCSIR-Science Technology & Innovation Park

Operationalization of PCSIR- Science Technology & Innovation Park, initially at Lahore, with the onus to create entrepreneurship ecology, support new start-ups, business venture and incubation of innovation-led, regional economic development through regional creativity as well as support to local industry's competitiveness. The listed below infrastructure related facilities have been established within available resources.

- National Innovation Centre/ Go Zero
- National Centre for Transfer of Technologies
- Technology Business Incubation Centre (TBIC)
- Management & Tenant Offices for Industries, Academia & relevant stakeholders
- Access to R&D Infrastructure, Workshops & Pilot Plants

After its successful operation activities, the same model will be replicated at PCSIR, Karachi & Peshawar. The draft documentations i.e., Regulations, ToRs for Tenants, Brochures & Applications have already been submitted to MoST for approval.

5.5. STRENGTHENING THE LINKAGES WITH ACADEMIA

Keeping in view the strengths & weaknesses of PCSIR, focus will also be given to listed below activities while establishing the linkages with academia:-

- Sharing of Human & Material Resources with the Public & Private Sector recognized Universities for utilization the services of their Business & Media Schools Young Graduates to supplement the marketing & commercialization activities of PCSIR's Products/ Technologies

- Sharing of PCSIR's Technical Infrastructure with Science Departments of the Universities. Through this arrangement, PCSIR can overcome the absence of marketing & media professionals, whereas, the Universities could have easy access to R&D infrastructure of PCSIR.

It is expected that this arrangement could be mutually beneficial for both the entities such as PCSIR can overcome its commercialization & media propagation weaknesses through utilizing the young graduates of the Universities. On the other side, the Universities will not have to make huge investment for creating state-of-the-art R&D facilities.

5.6. STRENGTHENING THE LINKAGES WITH INDUSTRY

In order to strengthen the linkages with Industry/ SMEs and to curtail the trust deficit with the industry, the following activities will be undertaken on regular basis:-

- Extensive visits to Chambers of Commerce & Industries, Sector Specific Trade Associations.

- Constitution of Technical & Marketing Teams for conducting industrial visits and holding of Focus Group Meetings with an aim to:-

  - Brief the industrialists about technical expertise/ technologies/ services available with PCSIR.

  - Identify the problems/ issues being faced by Industries/ SMEs.

  - Identify research projects as per demand of the Industries/ SMEs.

- Inviting business/ industrial delegates in PCSIR Laboratories for the awareness of PCSIR's Technical Facilities & Capabilities and to augment the **"Seeing is believing"** thought.

- Effective publicity campaigns & promotion of interactions with industries/ SMEs through organizing Seminars, Workshops, Technology Exhibitions etc.

5.7. SKILL DEVELOPMENT TRAININGS

- Apart from the regular diploma and certificate courses, the collaboration with the listed below Federal/ Provincial Vocational Training Authorities shall be enhanced to meet the demand of local industry:-
  - NAVTTC
  - Punjab Skill Development Fund (PSDF), Lahore.
  - TEVTAs (Punjab, Sindh, KP & Baluchistan)
  - FATA Development Authority, Peshawar etc.
- Northern areas of Pakistan are rich in fruit production and nature has gifted tremendous environment for world's best fruits having matchless taste. Despite the fact annual fruit losses are enormous in the area due to lack of knowledge/ skills for better production and preservation. Therefore, series of training programs for the Value Addition of Fruits and Vegetables shall be conducted by engaging local social groups with the listed below objectives:-
  - To train local community with skills/ techniques for preservation of fruits and vegetables.
  - To enhance income and employment opportunities for local communities.
  - To increase role of women and their participation in socio-economic development.

5.8. PARADIGM SHIFT IN R&D PROJECTS - CONSTITUTION OF ADVISORY COMMITTEE

Presently there is no tangible R&D projects framework in place in PCSIR having clear sighted road map in terms of its impact on the national economy and society. As such there is no appropriate mechanism to assess the market viability and potential of any research project/ invention. It has been observed that the mechanism of R&D and technology development operates in isolation, having little or no linkages with end-users. The Scientists/ Engineers/ Technologists of PCSIR developed processes/ technologies through in-house R&D projects but it is reality that most of the technologies/ products are placed on the racks due to many reasons like weak linkages between Research, Industry & Academia, trust deficit trend between private & public sector organizations, lack of focus on developing demand driven technologies, absence of marketing professionals and effective propagation activities etc.

Keeping in view the above, it has been decided that focus may be given to develop need-based/ demand-driven technologies which may immediately be accepted by the industrial sector. In this regard, an Advisory Committee is being constituted at PCSIR Head Office, Islamabad **to** select/ review/ recommend & approve the demand driven research projects for funding to streamline the research & innovation eco-system. The functions of the Advisory Committee shall be:-

- Formulate, approve & implement the strategic plans/ policies for changing in mindset and overcome the prevailing inertia through paradigm shift towards need-based R&D and introduction of Corporate Culture.

- Identify the potential areas of R&D in line with the national priorities, prevailing opportunities as well as of industrial demands through extensive Visits/ Focus Group Meetings with Chambers of Commerce & Industries and Sector Specific Trade Associations etc. will be arranged along with strengthening of institutional relationships with public sector organizations/ universities.

- Supervise and manage the R&D activities of the Council's labs./ units.

- Lump sum allocation of funds to labs./ units for demand driven/ need-based R&D projects out of PCSIR's Self Generated Income (SGI).

- Evaluate, review and recommend the demand driven/ need-based R&D projects submitted by PCSIR labs./ units in line with the identified areas and to accord its approval for funding through SGI.

- Monitor the progress of approved demand driven/ need-based R&D projects.

- Approve the technology transfer fee or product cost for commercialization to the end user.

- Approve the proposed Incentive Award determined/ recommended by the Sub-Committees on the basis of approved Incentive Reward mechanism.

- Monitor the progress of the Sub-committees to be constituted at labs./ unit level on quarterly basis.

- Devise & approve any other policy guidelines/ directions to strengthen the commercialization activities of the Council.

Moreover, Sub-committees are also being constituted at labs./ unit level to assist the Advisory Committee for implementing its decisions/ directions.

5.9. INCREASE IN THE SCOPE OF ACCREDITATION

The ISO/IEC 17025 accreditation is the single most important standard for calibration and testing laboratories around the world. Through ISO 17025 accreditation laboratories can demonstrate that they are technically proficient and able to produce precise and accurate test and calibration data.

Several laboratories of PCSIR located at Karachi, Lahore, Peshawar & Islamabad are accredited for ISO-17025 certification under the TRTA-I and TRTA-II Programmes sponsored by European Union (EU). More than 550 accredited tests/ calibration services are at the credit of PCSIR.

Keeping in view the importance of ISO 17025, PCSIR laboratories are continuously in a process of extension in the scope of accreditation of their labs/ centers. Efforts are being made to extend the scope of accredited parameters for cement, halal foods, food grade packaging materials, rapid testing of SPS organisms, calibration, etc. Labs have been asked to submit their accreditation plans which will be reviewed at the Head Office before formal application to the PNAC. It is expected that the cases will be submitted to PNAC by February, 2021 (03 months).

5.10. COMMERCIALIZATION OF PRODUCTS/ TECHNOLOGIES

A Marketing strategy and promotion plan has been developed as described below and expected to be implemented by :

a) Brochure for each product has been developed and distributed from time to time.

b) Advertisement in the media from time to time for raising awareness in public and potential customers for leasing out of PCSIR products and services.

c) MoST shall be requested to approach HEC, Ministry of Planning, Development and Special Initiatives as well as to direct the S&T organizations to encourage the purchase of PCSIR's developed laboratory equipment.

d) Strengthening of Research, Academia & Industrial Linkages.

5.11. INDUSTRIAL SERVICES

ISO-17025 accredited labs of PCSIR are providing technical services to almost all the industrial sectors of the country. Industrial support services like Consultancies, Technical Reports, Testing/ Analytical, Calibration, Repair/ Maintenance of Equipments and Quality Control Services.

Technical services will be increased through;.

a) Automation of ILO procedures (from sample submission to delivery of report)

b) Extension of the scope of accredited parameters for cement, halal foods, food grade packaging materials, rapid testing of SPS organisms, calibration, etc.

5.12. DEVELOPMENT OF BUSINESS PLAN

All Labs of PCSIR have been requested to develop and adopt business plan to meet the targets/ increase the output for self-sustainability. Business Plan will evolve around the given below areas:-

- In-house and Need-based R&D activities.
- Leasing out of technologies/ processes & products.
- Industrial support services like Consultancies, Technical Reports, Testing/ Analytical, Calibration, Repair/ Maintenance of Equipments and Quality Control Services.
- Development of Analytical Equipment and Fabrication of Machinery/ Plants.
- Human Resources Development.
- Strengthening the linkages with Academia & Industry.
- Propagation Activities

5.13. ENHANCEMENT IN INTERNATIONAL COOPERATION

PCSIR has signed several collaboration plans i.e. agreements/ MoUs with international organizations but none of them were properly implemented due to lack f funds to execute the plans. PCSIR has planned to establish an international coordination centre at Head Office to enhance international cooperation. The centre will oversee/ execute/ coordinate all international MoUs/ agreements and work for enhancement in the international collaboration. Task is expected to be completed by March, 2021 (4 months).

7. Financial Outlook

7.1. NEWLY APPROVED CONCEPT PROPOSALS

I) Cultivation & Processing of Medicinal & Industrial Cannabis on Experimental Fields and Establishment of Testing and Product Development Facilities at PCSIR Laboratories Complex, Lahore, Peshawar and Karachi

In pursuance of Prime Minter's directives regarding domestication and commercialization of medicinal and industrial cannabis. A follow-up meeting was held in the Ministry of Narcotics Control under the Chairmanship of Federal Minister for Narcotics Control on June 4, 2020 wherein interalia PCSIR was assigned task for the establishment of analytical testing and cannabis products development facilities in its laboratories/ research centers in the country. PCSIR has prepared a PC-I with the cost of Rs.1800 million for the industrial exploitation of cannabis.

The global legal cannabis market is valued at $17.7 billion in 2019, growing by about 22 percent, according to the report from Grand View Research. Spending on legal cannabis worldwide is expected to reach $42.7 billion by 2024 at a compound annual growth rate (CAGR) of 25% from 2019 and hit $57 billion by 2027, while cannabis market in the United States and Canada is estimated to be about $46.5 billion and other $10.5 billion would go to other markets. It is one of the fastest growing plants and was one of the first plants to be spun into usable fiber 50,000 years ago. It can be refined into a variety of commercial items, including;

- Paper
- Textiles
- Clothing
- Biodegradable plastics
- Paint, insulation
- Biofuel
- Food
- Animal feed.

ii. Pakistan needs to act swiftly to join this rapidly growing industry and earn foreign exchange worth billions of dollars through export of non-narcotics cannabis products such as Cannabidiol (CBD) oil, fiber and dozens of other products. There is no formal research, processing and value-added industry of industrial cannabis in Pakistan.

After successful completion of the project local facilities will be developed for cultivation and processing of industrial cannabis. Based on the experimental field data the same will be replicated in other parts of the country after seeking the required permission for its utilization on industrial scale/ export purposes. Moreover, local facilities developed in PCSIR Labs will be utilized for the development of products, analysis and testing of exportable products. The products so developed will be offered to industry for their commercialization (domestic/ export)

II) Development of indigenous raw materials for Minerals and Proteins for the development of products to substitute relevant imports / exports.

The objective of the project is to up-grade the facilities of Minerals Processing Research Centre (MPRC), PCSIR, Lahore related to exploit indigenous Minerals for the development of products to substitute relevant imports / exports by installing state of the art equipments, pilot plants and lab facilities. MPRC requires up gradation regarding methods of evaluation/estimation/wet and instrumental analyses/quality control, mineral identification/phase analyses and mineral processing methodology based upon differences of specific gravities of various constituents, mesh of liberation, magnetic and surface properties of minerals. This project proposed some additional equipment in the existing pilot plant and mineral processing, analytical and instrumental laboratories of the Centre. The up-gradation would be beneficial for utilization of indigenous ores, scrap and market available mineral based material. As a whole it would lead to import substitution and may save a lot of foreign exchange.

Leather and leather made-ups approximately contribute 4 to 5% to the country's GDP and fetches about USD 1.00 billion annually in exports. Thus making it a significantly important sector in the national economy. It is well known that leather processing generates very huge amount of solid and liquid wastes. These wastes contain about 30% of chrome tanned solid wastes (commonly known as chrome shavings) comprising approximately 60%-80% proteinious material. The traditional handling of these chrome tanned solid wastes is usually careless dumping which causes health, environmental and economic issues.

III) Digital Transformation, strengthening and Automation of PCSIR

Digitalization is the new norm. Public sector organizations specially need to have an enterprise-wide comprehensive digital infrastructure to carry out the business functions entrusted to them. In this regard, PCSIR, a public sector scientific research organization, has significantly lagged behind in adopting the modern digital communication and connectivity infrastructure to perform its functions in an agile manner.

Being a premier organization, PCSIR plays a pivotal role in establishing a strong scientific/ industrial research base, contributing towards innovation in industrial sector and promoting indigenization and commercialization. It has a 570-strong workforce of scientists & researchers supported by about 1200+ technical and administrative staff in multiple research facilities spread throughout the country. In spite of that, currently, PCSIR is having about 550 PCs of obsolete technology; no organization-wide internal network; and, still lack enterprise digital information systems and data-driven analytical decision making tools.

This project plans to digitalize and implement information systems in all facilities of PCSIR and automate business processes to enable a holistic picture of the activities for improved decision making by the top management. The project will include provision of latest computers, servers, printers, scanners, allied digital hardware, complete network infrastructure, scientific research software tools and automation of business processes for day-to-day activities as well as management decision making.

IV) Developing Techno-Economic Model and Digital Control System for establishing ISO 22000 Certified Bio-facilities.

With advancements in agriculture, establishment of high tech, controlled bio-facilities to grow various plants and crops is increasing. The main rationale behind this phenomenon is to have improved quality of food and industrial products using scientific methods, higher yield of crops/ plants, and precise amount of inputs, such as pesticides, fertilizers and soil moisture. Pakistan being an agriculture country has to move into this direction to fulfill its indigenous demand as well as to ensure producing high quality safe food products. Establishing ISO 22000-certified intelligent bio-facilities will pave the way for having high quality, optimum yield of crops and orchards, as well as cost effective and integrated processes in the food and allied processing industry.

PCSIR as a premier R&D organization has multi-functional Research Laboratories at Karachi, Lahore, Peshawar, Quetta and Hyderabad. Food Research Centre is an important facility within PCSIR, doing research on food processing. Moreover, PCSIR Labs Karachi is working on Plant Tissue Culture Techniques and is providing guidance to sugarcane growers to improve yield of sugarcane crop.

In order to keep a consistent quality in production processes for food products, it is essential to adopt ISO 22000 standards. This will result in highly safe, quality food products, as well as reduced operational/ production cost.

By Establishing ISO 22000 Certified Automated Bio- facilities will keep a consistent quality in production processes for food and allied industrial products. This will result in high output, safe, quality food products, with reduced operational/ production cost, which will pave the way for future economic growth & development and technology transfer as well.

V) Up-Gradation of PCSIR Laboratories for High Throughput Analytical Testing of Medical, Industrial and Metrology sectors.

PCSIR Laboratories being the national independent, infrastructure needs to be up-graded for high-tech analytical centers to meet the challenges in the field of physical, chemical and microbiological testing.

The key areas in which up-gradation is required are;

- Textile and Chemicals
- Leather and Leather Products
- Surgical Goods/ Bio-compatibility etc
- Foods
- Minerals
- Fuel and Energy
- Pharmaceuticals/ Herbal
- Fish and Marine Products
- Metrology etc.

The project will link high-tech analytical centers nation-wide to CPEC industrial zones, industrial clusters, export/ import entry points and other need-oriented points for sample collection/ inspection and online reporting of testing result system.

VI) Establishment of PCSIR Material Sciences and Resources Centre.

Engineering materials plays a significant role in the economic progress of a country and contributes directly towards the growth of the industrial sector, particularly; ceramics, plastics, metallurgy, aerospace, telecommunications, transportation, electronics, micro and optoelectronics, energy, healthcare, computing, consumer goods, composites and construction. The establishment of 09 special economic zones has been part of the C-PEC, where the setup of Building Materials, Automobile and Mechanical Equipment, Steel-Foundries, Motor Bikes Assembly, Ceramic industries are already being undertaken. It is necessary to provide highly trained manpower in these fields in order to meet the present as well as future needs of the country. Priority should be given to materials synthesis for prevailing ambient conditions of Pakistan and characterization techniques in order to understand and define the properties of materials. It is necessary that the latest equipment and research facilities are made available to the researchers. The National Science, Technology and Innovation Policy 2012 under section A106 also emphasizes on the Establishment of a National Materials Science Research Institute with a centralized supercomputing facility for computational materials science or condensed matter physics.

Material Sciences, Mineral and Resources Centre are established that will be beneficial for all engineering material sectors including ceramics, plastics, metallurgy, aerospace, telecommunications, transportation, electronics, micro and optoelectronics, energy, healthcare, computing, consumer goods, composites and construction

7.2. NEWLY APPROVED PSDP PROJECTS

I) Up-gradation of Halal Authentication Laboratories at PCSIR Laboratories Complex, Lahore, Karachi and Peshawar

The Halal food trade is about $350 billion globally, and the total Halal business market (including cosmetics, pharmaceuticals etc.) is approximately $1.3-2.2 trillion. It is every Muslim's religious obligation to consume only Halal food and other products and avoid non-Halal (Haram) ones. Due to increasing population, the Pakistani food industry cannot meet the local demand for Halal food; therefore, Pakistan imports approximately $50 million worth of processed foods, and almost the same quantity of food additives every year. However, due to technological advancements and the diversification of global sources for food processing and production, it has become very challenging and increasingly difficult for Muslims to ensure the Halal status of food. Adulteration of food with forbidden ingredients is a major issue in the food industry globally. This issue is not only a religious problem but also an economic and societal problem. Reports of Haram food incorrectly labeled as Halal entering the food supply in Pakistan have resulted in considerable upset and economic harm. Technology provides a potential solution through advanced chemical analysis techniques as well as improved education and training. Furthermore, perception of Muslims worldwide including Pakistanis nowadays has changed in Halal consumption which consequent to seeking more trusted certified Halal products. In some aspects adulteration of non-Halal in products provided for Muslims conflicts to consumer protection and other related law and regulations.

Taking into account the increase of Halal product's market and Halal authenticity, Halal Authentication laboratory has been established at PCSIR Lahore, Karachi and Peshawar. Up-

gradation of Halal Authentication Labs is crucial in the wake of ever increasing demand of Halal products. Bio-analytical techniques have been developed at PCSIR Labs Complex, Lahore, Karachi and Peshawar for the authentication of Halal products. The baseline work has been completed and now these facilities need the streamlining and strengthening to cover up the broad requirements of Halal authentication. Through this project, it is envisaged that the Halal testing on all aspects will be available in the country. The manpower will be strengthened both in number as well as capacity. The labs will be able to procure the required resources to undertake the challenging jobs related to Halal research as well. These labs will be accredited through PNAC.

II) Up-gradation of Machinery Equipment & Buildings of IIEE & PSTC, Karachi

The objectives of the project are:

- To enhance the standard of teaching and training facilities and technical infrastructure for IIEE& PSTC.
- To replace the outdated /aging equipment and trainers that will further develop expertise of skilled Graduates.
- To add latest / advance equipment so that the training standard may be kept at pace with modern trends in industries. These additions will invoke requirements for establishing new labs (or/and training equipment) for conducting training on state of art machines & equipment for Machining & manufacturing techniques and Experiments for;, Embedded System, Power Electronics; Industrial Instrumentation & Control and Communication.
- To repair & renovate the present infrastructure, centre's building, workshop, labs of IIEE & PSTC and PSTC Hostel.

III) Up-Gradation of Calibration Centre Capabilities at PCSIR Labs. Complex, Peshawar

Amplification of Calibration centre PCSIR Labs. Complex Peshawar is designed considering the need for regular calibration and maintenance of meteorological instruments to meet the increasing needs for high quality meteorology and testing, the requirements of the stake holders for standardization of instruments as per requirement of WTO, the need for international instrument comparisons and evaluations; it is intensive need of PLC to Augment the Calibration Centre.

After enhancement of capabilities the calibration centre will carry out more effectively the following main functions:

- To keep a set of updated meteorological standard instruments linked with recognized international or national standards and to log their performance and elements of comparison.
- To assist the stake holders of the region in providing traceable calibration services for their instruments in the vast ranges.
- To certify the instruments, conformity with the standards, with reference to ISO/IEC-17025 recommendations.

- With increased ISO/IEC-17025 accredited scope can meet the present market demand, It will create a supporting base for the local industries, as these facilities are not available in Khyber Pakhtoonkhawa.

- The Amplification of calibration centre will also provide a favorable ground for the execution of R&D projects in the PCSIR Peshawar.

IV) Establishment of PCSIR Laboratories, Multan Punjab

This project is related to food, textile and advance material engineering and will provide innovative products. The project will provide a platform for the rapid promotion of scientific knowledge in the field of foods especially citric fruits, textile and engineering materials. It will also help in making the country self-sufficient in this field.

Analytical services, technical support and consultancy services for the food, textile and advance material industry is also lacking in Multan area, so it was decided to establish PCSIR Labs. at Multan.

The important factor which effects Pakistan's fruits export accounts for post harvest losses due to improper treatment, handling between the time of harvesting and delivery to ultimate consumers. Inadequate facilities in post harvest handling, transportation, storage and marketing result up to 30-40% losses in fruits (Pakistan Horticulture Development and Export Board, 2002). This is due to unawareness of the farmers about the latest fruit handling and processing technologies. According to Valentine (2010) it is estimated that through improved handling and harvesting practices, about half of that wastage is save-able or at least 180,000 tons per year. It is also assumed that this is the maximum amount for processing value added products (Pickles, Jams, Juices etc.) of which dried mangoes are only small percentages. Therefore, it is very much important to establish PCSIR Laboratories having fruit processing facility near fresh raw material supply to train the local farmers. This may also reduce the average production cost by reducing the wastage of precious fruit and lessening injury for handling and deterioration from changes during long transportation after harvesting. Moreover the transportation charges are eliminated. The major scope of processing activities will include post harvest handling, pre-cooling, grading, ripening, packing and logistics. Fruit processing will also provide services to other exporters who do not have their own processing facilities including cold transportation service up to the port of exit.

Textile is the leading industry of Pakistan and is the backbone of our economy. The Textile industry in Pakistan is the largest manufacturing industry as well as the second largest employment sector in Pakistan. Despite being the fourth-largest producer of cotton, Pakistan is not even in the list of top 10 exporters. At present about 60% of our textile exports consist of low priced products like yarn and fabric while exports of value added products are only about 40%. This sector has engaged about 38 % of work force. Pakistan is one of the giant to produce cotton and export the cotton and also 3rd rating in the world for the consumption of cotton. But the demand of fine yarn is increasing with long staple fiber. Despite of this, global market has taken the new direction. It goes to the consumption demand to 70 % of man-made fiber consisting of 45% polyester blended fibers.

7.3. SELF GENERATED INCOME (SGI)

Present Revenue Generation Areas

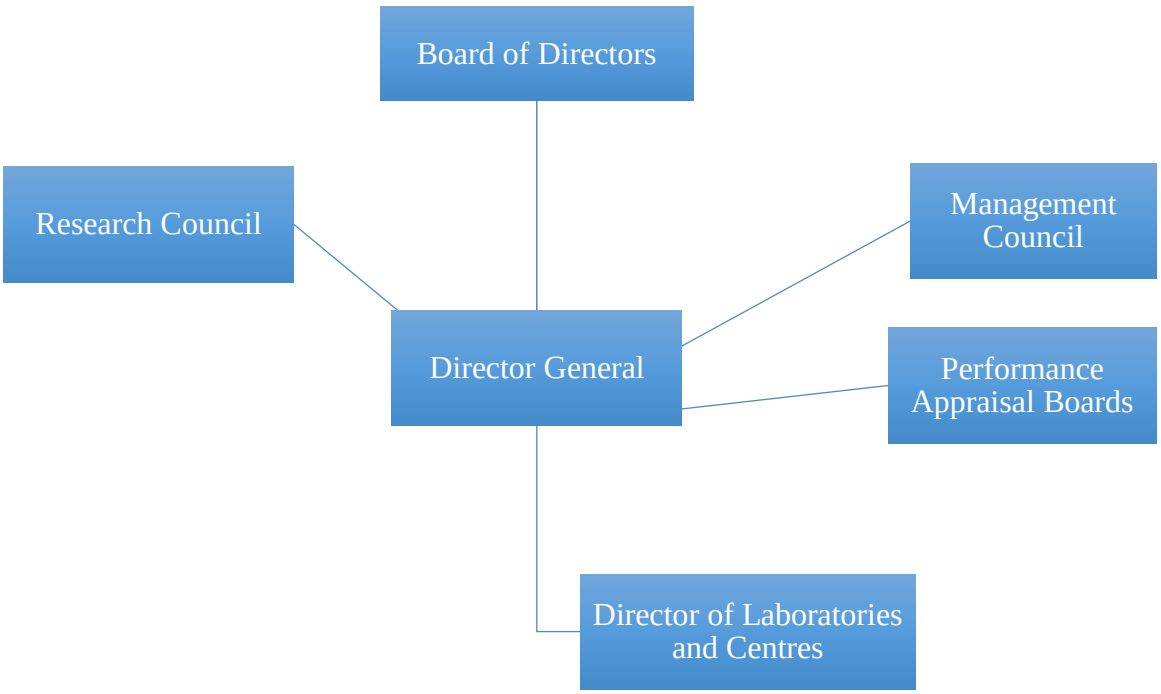
- Leasing out/ Transfer of Technologies/ Products/ Processes/ Royalty etc.
- Analytical Testing/ Calibration Services.
- Consultancies/ Collaborations/ Trainings/ HR/ Funded Projects

Plans for Increasing SGI

- Introduction of Incentive Award scheme for paradigm shift towards need-based R&D.
- Commercialization of Products/ Technologies through establishing Technology Business Incubation Centres (TBICs).
- Automation of ILO procedures (from sample submission to delivery of report)
- Extension of the scope of accredited parameters for cement, halal foods, food grade packaging materials, rapid testing of SPS organisms, calibration, etc.
- Development of Business Plan

Annexure 2

Proposed Structure of PCSIR



Indicative Research Themes

1. Chemicals
2. Biological and Genetic Engineering
3. Materials for Industrial Use
4. Metallurgy and Mining
5. Pharmaceuticals and Drugs
6. Physical and Standards
7. Precision Engineering
8. Industrial Electronics and Engineering