

Human Resource Management at Bangkok Science and Technology Institution^{*}

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Examining the latest scores prepared by the external evaluation agency, Siriwan Pantana, the recently appointed governor of the Bangkok Science and Technology Institution (BSTI) quickly surmised that the organization's human resource system had some distance to go to fulfill its strategic mission of becoming the driver of employee effectiveness and performance. As reported by Standards and Evaluation Committee, employees continued to rate BSTI low on several dimensions, despite the initiatives that the Human Resource Department had taken, at Siriwan's direction, to bolster the human resource system.

Overall, BSTI was perceived as being too bureaucratic, with too many rules, regulations, procedures, and the like-constraints that employees rated as limiting both their personal satisfaction on the job and their effectiveness in their work. Similarly, based on

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another rating, a disturbing number had opined about too many career “layers” , leaving many frustrated and concerned about their prospects for continued advancement. These and other areas of the report were disquieting, to say the least.

Since her appointment to the post of governor in March 2006, Siriwan had worked hard to overcome employees’ longstanding view of the HR Department as the organization’s policeman charged mainly with developing and promulgating rules and regulations, monitoring employees to spy infractions, composing warning and dismissal notices, and the like. Since Siriwan’s arrival, the HR Department, which now reported directly to her, had been given an enlarged and strategic mission to facilitate the highest possible levels of employee effectiveness by helping employees attain the highest levels of both satisfaction and productivity. Only with a workforce imbued with high levels personal satisfaction in their work and high levels of performance would BSTI, in Siriwan’s view, be able to retain its competitive vitality against other organizations in its service sectors.

To this end, Siriwan had endeavored to provide the HR staff with a new vision of the new strategic role assigned to them. A number of staff had been sent for training in the new concepts embodied in the mission of strategic human resource management, in the hope and expectation that such insights would be of practical value when they returned to BSTI and applied these concepts to the new role required of them. Siriwan had also pressed for the development of HR systems, which they believed were the keys to development of highly energized highly committed and highly satisfied employees, who would in turn deliver high performance.

But now as she studied the report from the external evaluation agency, the HR system was not yet yielding the results that she had expected. But, if BSTI was to develop the caliber of workforce that would augur well for its ability to hold its own against encroaching competition, Siriwan knew that she had determined where the impediments lay whether in the HR Department or in the HR system, or both and take corrective action.

Development of Bangkok Science and Technology Institution

In 1960s, the government acknowledged the importance of research and development in science and technology for the country's economic advantage. With the aid of the United Nation (UNBTAO), the plan for developing a research institution in Thailand was hatched from the study of the Commonwealth Scientific and Industrial Research Organization (CSIRO) in Australia. The Applied Scientific Research Corporation of Thailand was founded with both the government and UN funding in 1963, with the name later changed to Bangkok Science and Technology Institution (BSTI).

As the country's first research agency, Bangkok Science and Technology Institution was established the government's vision to advance scientific and technological expertise in Thailand. BSTI was non-profit state enterprise under the umbrella of the Ministry of Science and Technology.

At BSTI, a diverse range of research from agricultural technology, biotechnology to materials technology was generated to cover areas to improve the economy and the community. Our staffs at technology were generated to cover areas to improve the economy and the community. Our staffs at technology transfer, metrology and testing services divisions were more than willing to train and provide consultancy to the private sectors and small to medium sized entrepreneurs. We were proud to be the main source in expanding scientific knowledge to the public and enhance the well being of the people using our own technology and resources.

Vision

As the country's first research agency, Bangkok Science and Technology Institution was established pursuant to the government's vision to advance scientific and technological expertise in Thailand. From the beginning, BSTI's vision was to be an organization that produced commercial technology to increase the national social and economic capital, as well as developed appropriate environmental and ecological technology to enhance the sustainable national competitiveness. BSTI was organized as non-profit state enterprise under the umbrella of the Ministry of Science and Technology.

Mission

With this mission, BSTI pursued a diverse range of research — from agricultural technology to biotechnology to materials technology aimed at improving the economy and the community. The Institution's staffs in the technology transfer, metrology and testing services divisions were more than willing to train and provide consultancy to the private sector and to small to medium sized entrepreneurs. Over the years, BSTI had taken considerable pride in being the main source in expanding scientific knowledge to the public and enhancing the well being of the people using own technology and resources. The details of mission were:

1. To conduct research on science and technology that comforts to the national plan and policy and the needs of industrial sector as well as to utilize its results extensively in order to create national economic value.
2. To render scientific and technological services on analysis, testing, calibration, and other services to support the quality standard improvement of both public and private sector.
3. To enhance scientific and technological knowledge for social development.

Structure of Bangkok Science and Technology Institution

The governor is the head of the Institution. There are almost 700 employees in the institution (see appendix 1 and 2). The institution is divided into 4 groups. They are research and development group, technology transfer group, services group, and administrative group (see appendix 3). The following paragraphs explain in details:

Research and Development Group consists of food technology department, pharmaceutical and natural products department, postharvest technology department, agricultural technology department, biotechnology department, microbiological resources center and ecology and energy department. We see that these departments are working from designing the production process of ready-to-eat products, enhance process improvement for small and medium sized enterprises or SME, developing on medicinal plants to be used as raw material,

medicines or drugs or healthy food, including improving soil conditions and crop yields and to up-grade quality of agricultural products and developing projects concerning environmental impacts on the ecosystem as well as an efficient use of energy (see appendix 4).

Technology Transfer Group consists of rural technology transfer department, research station management department, industrial and technical consultancy department, and training department. These departments are responsible for develop and transfer of appropriate technologies to rural communities in order to improve income and living standard, administer and manage three research stations for transferring knowledge to students, farmers, and public including provide services to both public and private sectors in the workshops, seminars, training (see appendix 4).

Service group consists of industrial metrology and testing service center, material properties analysis and development center, Thai packaging center, and Thai national documentation center. They are responsible for providing services on testing and analysis of industrial products and raw materials, services on analysis and testing of materials and products with an emphasis on metallic materials, improve and maintain product quality, decrease losses, increase export and upgrade packaging standard of the country (see appendix 4).

Support service group has the duty to support different segments in the BSTI. The first segment is the Central Administration and Service Sector which carries out development work according to the BSTI's and the national policy for example, developing the BSTI's new office at Techno Thani, reducing excessive bureaucracy in public service, internal auditing standard and risk management.

Other segments include the Research and Development Sector, the Technology Dissemination Sector, the Service Sector and the Administration Sector the BSTI also consists of the Governor, Policy, and Planning Office, Internal Audit Office, Office of the Certification Body and Fertilizer Technology Center (see appendix 4).

One morning in March 2007, there was a meeting about employee issues in the human resource committee who had representatives from human resource department, policy and planning office, Thai packaging center, rural technology transfer department, and research and development office. There were about 7 committee members and one of the agenda was how to increase effectively and efficiency productivity from the employees. One of the committees had said that there was low moral in the Institution which caused employees not willing to work well. We needed to begin to look at the recruitment process if it was well established. At the present time, the recruitment was beginning from announcement into the public so anyone who was interested was able to apply. Then, they must send the resume as the requirement. If that person passed the first stage, it would go on for taking a test and interview. That committee member felt that these processes would not be enough. It required more such as we might let the applicants worked as a team on the case based and have the interviewer watched from the back of the room. The reason was that we need new young blood to work as a team in the Institution. This way, we could observe who was leader or follower.

Furthermore, we never had orientation for new employee. It should be considered on this issue and should have extra activities for outdoor in order to make closer friendship. The other committee member said that the human resource department sometimes place the wrong employee to the wrong place when they could not find the position. They worked and never read the job description. It caused a lot of problem because we got the wrong guy in the wrong position. This created employees not to function well because they did not have enough confident to do the job. At the Institution, we required employees with the highly confident on the job and had ability and knowledge to do the job.

There were some observations from a few committee members about the value and believes that happened around the Institution. They felt that there were the different of value and beliefs among new and old employee generation. The old generation employees were willing to work, work hard, always thinking about the Institution first, and appreciate all the rule

and regulation from the Institution in order to reduce the conflict. However, the new generation had different value and believes such as they had no commitment, did not stay long in the Institution, highly technology, highly personal life, not listen to their boss so much rather they listened to themselves more. The group got highly rate turned over. It caused a lot of money from the Institution to train or retrain.

Human Resource System

The BSTI's Human Resource System was charged with keeping abreast of employee needs and determining the ways to achieve them. As set forth in the Vision Statement for Human Resources, the overarching objective was to ensure that all 700 employees had competency in research and development, were capable of providing service in the area of science of technology at the international level, and possessed creativity and a positive culture.

Overseeing the Institution's Human Resource System was a human resource committee, comprised of the deputy governor for administration, the director of human resources, and many senior HR staff members. This body was responsible for monitoring and measuring the HR's progress in managing the various policies of the HR system. The five basic HR policies—aimed at achieving the overall of having BSTI employees “develop themselves to be excellence and become research and development professionals” were as follows:

- develop ability, knowledge, attitude and behavior continuously,
- develop human resource development in order to be a mechanism for the institution
- develop employees in every career, level, and position
- support the institution to have knowledge management
- develop quality and quantity of employee's competency

To implement these policies, several ongoing systems were devised and integrated into an overall Human Resource System. These were recruitment and selection, human resource development consisting of training and career development endeavors, and an HR information system.

Recruitment and selection

The problem of recruitment is that the institution is hardly recruit highly qualified candidates to work here. Let see the process of recruiting requirements. The institution would announce for the vacant position to the public with qualification requirements. Then, the committee would read through the resume and if they see anyone who qualifies, they would invite for interview.

The recruiting process here usually began with a detailed job description and job specification. Without them, it was impossible for recruiters to determine how well any applicant fits the job.

For example, there was a recruitment problem occurred in the department of agricultural technology. There were two positions available in the department. The human resource department had advertised on the newspaper and website regarding to the positions for 6 months and only one person applied for the position. The job was included emphasized on new technology to improve soil conditions and crop yields and to up-grade quality of agricultural products. This kind of job required a highly skill, ability, and knowledge to work on. It could be so specific job that less people know.

Human resource development

Training is important for new or present employees. Training is an attempt to improve current or future performance. The following specific points are important to know about training. Training is the systematic process of altering the behavior of employees in a direction that will achieve organization goals. Training is related to present job skills and

ability. It has a current orientation, and helps employees master specific skills and abilities needed to be successful. Both formal and informal training are an effort by employers to provide opportunities for the employees to acquire job-related skills, attitudes, and knowledge. BSTI offers performance management training, competency based training, restructure work training. However, the employees' attitude is that they see training program as a place for their relaxation, not willing to learn and develop themselves. How can we change their attitude?

Career Development

The institution offered numerous opportunities to employees. They were staff exchange, career promotion, a tuition reimbursement program, career path. The career development will assist employees in determining employees' career needs, develop, career opportunities in the institution. Career opportunities provide a broad range of information about available jobs and the qualification needed to fill them. It provides a system through which qualified employees may apply for these positions. It encourages a meaningful dialogue between employees and supervisors about employee's career goals. However, the employees feel that career development in the institution is unclear and the ones who got promotion always seen as the one who work closely to the boss. There is an unfair evaluation for career development. The issues had been discussed many times in the human resource meeting which Siriwan was chaired. The HR department said that career development needed to be restructure through out the organization so that it could attract and retained good employees. The HR department proposed to hire outside professional consultant to help the Institution to do so. However, there were some people who agreed and disagreed. So far there was no solution yet.

Human Resource Information System

Human resource information system refers to a personnel data system, an employee information system including computers as an integral part of their management process. Human resource administration is largely an information-handling business, so straightforward

record keeping and reporting, are its most basic jobs. Human resource professional may require information on basic subject as personal employee information, wage and salaries, benefits, education and training, attendance, performance appraisal. The range of such topics demonstrated the scope of the personnel function and the need for an automated system. Users can view this information on-screen and in reports. Depending on the capability of the individual application, a report may come in any of several forms- text, tables, graphic or combination. These reports include profiles and listing of individual employees, summary reports, historical trends in work-related information, person-position comparison.

The institution believes that human resource information system can make people in personnel department act as a business partner. There are two reasons. First, the personnel department is able to do management succession planning, manpower forecasting, and executive compensation administration which go far beyond personnel record keeping and reporting. Secondly, there is a lot of advantages for the institution. Computerization brings numerous benefits to the human resource department. Computer can increase data accuracy, increase processing speed, and productivity.

There were some older generation who did not accept the system such as people in the policy and planning department, research and development department. They thought that the system would replace human being so people could lost the job and became less important.

The External Evaluation Agency

It was a human resource committee who report directly to the Governor of BSTI about the result of the external science and technology evaluation association. The Association had come to visit and evaluate the BSTI for 3 days. The human resource committee who met the Association so they had reported to the Governor of BSTI as follows:

There is a lack of human resource system in order to develop the institution. It can create the problem in the area of human resource policy, compensation, recruitment and maintain people. Job description is not clear and some position has no job description. There is no summary of job position, job evaluation. Salary payment does not relate to the position structure. There is less technology to assist human resource job to work more effectively and efficiency. The external evaluation agency had evaluated BSTI looking at: HRM&HRD policy, recruitment and selection, compensation and benefit, performance management, HRD, communication and labor relation, disciplinary, HRIS, safety and healthy.

The result of evaluation showed that manpower planning has no summary of need of manpower planning in each budgeting year, no review for manpower planning. The institution has job evaluation but no comparison between the institution structure and compensation level. Benefit of the institution is based on the labor law. The institution developed performance appraisal in each position related to salary's increase, however, performance appraisal doesn't relate to career promotion. In addition, key performance indicator is unclear. There are competency for employees but no competency gap. So, it causes the difficulty to conduct training or training road map.

The Challenge for the leadership

The Governor was disconcerted to read that the external evaluation agency had found a lack of a human resource system at BSTI. She was further dismayed to read that the agency found unclear job descriptions, salaries that were not aligned with position structure. The governor and the board did not really support HRM & HRD policy since the policy was the strategy map for the Institution. In order to improve the Institution, it required the commitment from the Governor and the board.

The report, she felt, was a clear indication that the HR system had yet to deliver on its promise. It was time to get the bottom of why the System had proven incapable of transforming employees into the creative, highly productive, and highly satisfied workforce that BSTI desired-and increasingly needed. Could it be, she wondered, that the results to date were mere reflections of the fact that change takes time to produce results? Or, had BSTI overlooked something critical in its approach to strategic human resource management? Whatever the case, she was determined to get to the crux of the matter without delay, so that improved results could be generated by the time of the next visit by the external evaluation agency.

Appendix1

Employees in BSTI (30 September 2007)

	Business Development & marketing Group	R & D Group	Technology Transfer Group	Service Group	Administrative Group	Total
Full-time employees	1	180	72	174	171	598
Part-time employees	-	2	21	3	14	40
Temporary employees	-	12	11	14	15	52
Total	1	194	104	191	190	690

Appendix 2**Employee's Education Level**

Education Level	Business Development & Marketing Level	R & D Group	Technology Transfer Group	Service Group	Administrative Group	Total
Doctoral Degree	-	25	6	8	4	43
Master Degree	1	80	29	45	44	199
Bachelor Degree	-	56	24	107	95	282
Below Bachelor Degree	-	19	13	14	28	74
Total	1	180	72	174	191	598

Appendix 3

Evaluation by the external agency

Criteria	Year of 2006	Unit's responsibility
1. HRM & HRD Policy	3.72	HR Dept.
2. Recruitment & Selection	4.10	HR Dept.
3. Compensation & benefit	2.75	HR Dept.
4. Performance Management	4.56	HR Dept.
5. HRD	2.20	No one
6. Communication and Labor relation	3.60	Labor relation Unit
7. Disciplinary	4.20	Labor relation Unit
8. Human resource Information system	4.62	Personal Unit
9. Safety and healthy	2.90	Safety and healthy Committee
10. Advice form HRM Unit	2.90	Safety and healthy Committee
Average point	3.61	

Appendix 4

Research and Development Group

Food Technology Department

The Food technology Department has a long experience in designing the production process of ready-to-eat products. Its capabilities in machinery development enhance process improvement for small and medium sized enterprises or SME. The activities are production process of ready-to-eat products, process improvement for small and medium scale food industries, research and development by-products utilization from food industries, testing/analysis services and consultancy on food products. The research includes various products from lemon, modified and preserved product from fruits, concentrates and ready-to-drink fish soup, protein extracts from shrimp heads for commercial purposes, vegetable cleaning machine, tamarind juice extractor, and potato-peeling machine.

Pharmaceutical and Natural Products Department

The mandate of the Department is to carry out the complete cycle research and development on medicinal plants to be used as (biological active) raw material, medicines or drugs, health foods, cosmetics, aroma and other related products. The efficacy and safety of the succeeded out-come products do meet the international standard and are well supported by the scientific data.

PNPD also provides services and/or could certify on phytochemical and chemical analysis, biological study and assay to serve the needs of the government and private sector.

Examples of the PNPD R&D achievement: Topical anti-inflammatory, PLYGESAL CREAM and PHLAI GEL; Topical anti-fungal, TROLOL CREAM; Topical anti-jelly fish venom, IPAS CREAM; GARLIC NATURA, a health food product which was proved as a blood cholesterol lowering agent etc. Some economical important medicinal plant handbooks are also available i.e. chilli, ginger, turmeric and so on.

Postharvest Technology Department

This department is responsible for research, development, and transfer of postharvest technology of fresh horticulture produces of export potential Quality assurance system has also been developed to ensure international quality standards of Thai fruits in the competitive world market.

The notable achievement of this department is the Research Project on Sulphur Dioxide Fumigation in Postharvest Handling of Fresh Longan for Export which received an award from the Office of the National Research Council as an excellent research performance in Agriculture and Biology for the year 1998. The other highlight of R&D activities include technology on the use of ethylene absorbent in fruits packaging for export, controlled atmosphere storage and modified atmosphere storage of fresh fruit, precooling technology prior to transportation, fruit surface disinfection technology and surface coating technology of orange, pineapple and durian.

Agricultural Technology Department

This department places emphasis on new technology to improve soil conditions and crop yields and to up-grade quality of agricultural products. Techniques of plant tissue culture, DNA finger printing, surveying and collection of rare and endangered plant species are used to develop new plant ornamental crops with high potential to improve income of farmers

Research achievements include; discovery and development of 2 new species; *Magnolia sirindhorniae* Noot & Chalermglin and *Magnolia thailandica* Not & Chalermglin; improvement of tomato varieties for hill tribes together with the Royal Project Foundation; design and fabrication of Harvester and Shredder of Water Hyacinth and Waste Water Treatment System in Saha Phathana subsidiary industrial Park in Kabin Buri.

Biotechnology Department

This department is responsible for research and development from plants, animals and microorganisms which have a wide application in industry, agriculture, environmental rehabilitation and conservation, waste treatment and waste utilization. The other activities include service on analysis and problem solving of damages caused by microorganisms in agricultural and industrial products as well as consultancy service.

Research highlights are the Pilot Scale Production of Ethanol from Cassava and Agricultural products, the Development of Biofertilizer, Organic and Chemo-Organic Fertilizers which are very well accepted by the farmers and the transfer of such technology to industry has been accomplished. The use of pure microorganisms to produce fruit wines from local Thai fruits is also one of the projects acknowledged for its practical use by the producers. Another achievement is the development of microorganisms useful for economically important livestock industries such as probiotic for chicken, fishes and shrimp as well as live attenuated vaccines against animal diseases.

Microbiological Resource Center

This center was established with the support of UNEP and UNESCO in 1976 to be a focal point of the country for culture collection and services and a regional center for Southeast Asia. The principal activities are research on biodiversity of bacteria, yeast, fungi, and microalgae in the ecosystem of Thailand, culture collection of authentic microorganisms important for biotechnological and agricultural development, industry, environment and microbial research, services on culture supply, microbial strains preservation, public and safe deposit and identification of microorganisms, and technical training on isolation, identification, characterization of microbial strains and culture collection management.

Environment, Ecology, and Energy Department

This department has undertaken research and development projects concerning environmental impacts on the ecosystem as well as an efficient use of energy. Their activities are study and design of wastewater and solid-waste treatment systems, development and promotion of clean technology in production processes and efficient energy consumption in the industries, research and development on renewable energy from waste/industries by products and energy conservation in industrial plans and buildings.

Materials Technology Department

This department is dedicated to innovative development of advanced ceramics, membrane polymer and advanced materials. Their services are research and development of advanced ceramics and membrane polymer, research in conversion of waste materials into ceramics and other industrial applications, testing/analysis/consultancy of ceramic products, minerals and other industrial materials, and development and production of moulds and prototypes using rapid prototyping technique.

Engineering Department

This department conducts research and development on engineering of products and manufacturing system to serve the needs of industries and rural communities. The scope of responsibilities are as follows: engineering cooperation and support of manufacturing process and process improvement, engineering support in design of products including development of equipment and machinery, and advisory services and problem solving of processes liquid and gas waste in industry.

Technology Transfer Group

Rural Technology Transfer Department

This department is responsible for the development and transfer of appropriate technologies to rural communities in order to improve income and living standard as well as conserve environment and make proper utilization of valuable natural resources. The scope of activities are described as: technological development in relation to need and practical uses of rural communities, provide technical consultancy services to other government offices and private sectors in relation to rural development, networking development for the benefit of cooperation and rural technology transfer activities, conduct rural technology transfer activities by means of seminar, workshop, and technology incubation.

Research Station Management Department

This department is to administer and manage three TISTR regional stations which are Sakaerat Environment Research Station, Lam Ta Khong Research Station, and Coordinating Center for Highland Agricultural Development with the following scope of activities; research and development and technology transfer to farmers, students, and the public, planning and organizing essential facilities of the stations and dissemination of knowledge and research results to researchers and other interested individuals.

Industrial and Technical Consultancy Department

This department is responsible to transfer technologies to small and medium enterprises, to implement quality assurance management system to industrial sector, and to render consultancy service to the government agencies and private enterprises in the area concerning natural resources planning, environmental impact assessment, feasibility study of specific projects.

Training Department

This department provides services to both public and private sectors in the forms of workshops, seminars and training on the frontier of S&T applications and advance technology concerning e.g. food and drug, agriculture and biotechnology, energy and environment, standard production, quality-assurance system, engineering production, material properties development, packaging technology, construction materials, administration and management and rural development. Training is also organized at specific request, particularly of small and medium enterprises (SMEs) in order to develop human resource's skill in regard to production cost reduction, production-process improvement, quality assurance system in accordance with WTO 's standard so as to produce quality products generally accepted locally and also in the world market.

Services Group*Industrial Metrology and Testing Service Center*

This center is responsible for providing services on testing and analysis of industrial products and raw materials, consultancy service to SMEs and community which produce one tumbon one product's goods as well as calibration of industrial measuring devices and laboratory instruments. Their jobs are to analysis and testing products for export, register with Food and Drug Administration and apply for standard certifications from Thai Industrial Standards Institute, calibration of electrical and electronic meters, photometric instrument, temperature, and mechanical engineering, training and workshop on program analysis testing and calibration.

Material Properties Analysis and Development Center

The center was established under the Thai-German Government Cooperation project in 1994 in order to be the focal point for materials and component development and to enhance production capability and quality improvement of export products to meet the world

standards. Their responsibility is to render services on analysis and testing of materials and products with an emphasis on metallic materials including component, product, process structure, equipment boiler pressure vessels and automotive parts, to evaluate service life of materials and components, to provide consultancy service and solution to the problem on failure of materials, evaluation of performance of components , product improvement and risk assessment in production processes, to develop new materials products, processes and to support research, to provide training and seminar programs for industries and government agencies

Thai Packaging Center

This center was established according to the National Economic and Social Development Plan with the goals to improve and maintain product quality, decrease losses, increase export and upgrade packaging standard of the country. A team of researchers are dedicated in developing our own packaging products to serve the country's industrial sectors. The activities include research and development on packaging to enhance competitiveness in the country's economy and SME's, provide packaging information services and consultancy of international standards to develop quality and standards of packaging in the industrial sectors, provide testing and analysis of packaging materials to the industrial sectors, conducting seminar and training courses for personnel development in Thailand and the ASEAN countries.

Thai National Documentation Center

This center is a unique part among many parts of BSTI which has its function is establishing society of knowledge and learning by using electronic media to facilitate information service for science and technology research and development. The center provides literature search service, acquisition service, current awareness service, and information file service.

Support Service Group

The administrative team has the duty to support different segments in the BSTI. The first segment is the Central Administration and Service Sector which carries out development work according to the BSTI's and the national policy for example, developing the BSTI 's new office at Techno Thani, reducing excessive bureaucracy in public service, internal auditing standard and risk management.

Other segments include the Research and Development Sector, the Technology Dissemination Sector, the Service Sector and the Administration Sector the BSTI also consists of work groups under the responsibility of the Governor. These groups are the Office of the Governor, Policy and Planning Office, Internal Audit Office, Office of the Certification Body and Fertilizer Technology Center.