Economic Policy Paper
on
Assessing Appropriate Technology for SMEs

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Economic Policy Paper
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Assessing Appropriate Technology for SMEs In the Changed Business Perspectives

1. INTRODUCTION

Today the process of globalization has encouraged the Multinational companies to spread their branches and offices all over the world. Globalization has inevitably kindled keen competition in the operations of all business. This competition has generated a need among all the enterprises ranging from small and medium enterprises (SMEs) to large entities to adjust their strategies for their survival. A large number of multinationals have reached the limits of the traditional model for generating growth by just inventing new products and selling them out worldwide. These products therefore saturate many global markets.

Taking advantage of their size and strength, most multinational companies are developing critical sets of competitive intelligence tools. They have fundamental and applied research units and have specific departments dedicated to gathering and analyzing new trend and technologies in commercial and marketing intelligence. SMEs, on the other hand, for their small size and lack of skill in technology development are inherently in a disadvantageous position to compete with the large firms in the global arena.

Inspite of all these adversities, the governments of many countries particularly in the Asia, after the financial crisis in the Continent in mid 90's, have placed emphasis on SMEs. They believe SMEs will be the new driving forces for economic growth in the future. There is also a general belief that the future accelerated growth and sustainability of SMEs will largely depend on the use of appropriate technology and acquire and absorption of knowledge by them.

This paper aims to provide SMEs including those in the field of Electronics, Software, Light Engineering and Agro-processing industries in Bangladesh with elements of appropriate technology and knowledge of utilizing them to be more competitive in the market—both home and abroad. Successful SMEs will be those, which would be able to acquire, integrate and apply these technologies in their overall strategies for their survival in the global competition. The paper also includes a set of suggestions for appropriate technology policies for SMEs in Bangladesh in the changed business perspectives. In this paper, in the absence of any unified definition of SMEs,? cottage, small and medium scale industries as provided by the industrial policy of the country has been considered as SMEs.

2. APPROPRIATE TECHNOLOGY: WHAT AND WHY?

Technology, first of all, is a process by which certain resources such as land; material, manpower, skill etc. are utilized to obtain some desired products like food grins, clothing, household goods etc. The word technology tends to conjure up picture of large factories, huge automobile plants, gleaming jets etc. These, of course, represent the icons of modern technology. But technology encompasses a great deal more. The small sawmill, tiny bakery or handlooms of a weaver is also integral part of mosaic of technology. Technology can thus be defined as the method or technique for converting inputs to outputs in accomplishing a specific task[1].

Appropriate technology is that set of technology that is appropriate to meet the needs and the development goals of a country[2]. For a developing country like Bangladesh appropriate technology may be a mix of modern, intermediate and simple technologies[3]. Appropriate

technology aims at a better balance of the three levels of technology that is modern, intermediate and simple or traditional in order that (a) effective and sustainable development and (b) accelerated growth can be achieved and (c) firms use them can stay competitive with their products.

It has been seen that the appropriate technology helps to accelerate the process of:

- Building indigenous skill, innovativeness and entrepreneurial attitude. It tends to release greater creative potential of the people; and,
- Utilizing a great deal more human and material resources available within the country.

It is worth emphasizing that appropriate technology does not imply rejection of modern and sophisticated technology. For example, fertilizer plants represents modern technology and they are appropriate for Bangladesh. Also appropriate are such sophisticated technologies as satellite imagery and remote sensing techniques for determining crop production and natural resources and for forecasting cyclone or floods. In fact, modern technology can bring success in many ways. For example, the miracle rice, irrigation dependent IRRI was successfully modified into high yielding varieties of Aman (BRRI, 4, 10, 11 etc.),? a major variety of rice crop in the country, by the local research technologists. This technology helped to achieve a break through in the food production of Bangladesh and as such is successful specimen of appropriate technology in this area in the country.

Thus appropriate technology should be understood as a dynamic technological concept and not just a policy of manufacturing low cost traditional items. It should have the following characteristics[4]:

- It should stimulate or contribute to economic progress by making use of the local resources, manpower and material.
- It should represent technical progress by raising technological levels of existing methods.
- It should have an evolutionary capacity, so that progressive transformation of technology can occur.
- It should represent social progress by enhancing the process of productive employment generation.

3. APPROPRIATE TECHNOLOGY FOR SMEs

The globalization has made SMEs to operate in a very competitive world. They usually fill in gaps that large enterprises currently cannot serve, though there is a tendency still exists with the large firms to enter into such niche markets. They occasionally do it by spinning off small departments or by purchasing small firms. SMEs must therefore be creative and innovative and keep on improving their technology and operation techniques. In fact, due to their limited resources it is difficult for SMEs to directly invest in or invent any new technology. But this can be done comparatively cheaply through technology and knowledge transfer.

The present trend of globalization of trade defies the classical notion of appropriate technology. Now it imparts a dynamic growth pattern instead of static one—a characteristic that originates from its classical definition. The present market trend demands structural changes at the enterprise level and a shift from traditional to better production techniques. This generally requires higher capitalization to manufacture acceptable products for the competitive market though this capacity is beyond the reach of most SMEs. Thus appropriate

technology for SMEs has to be seen as the most suitable package of production techniques covering related production sectors and in the context of dynamics of production in the sectors over time.

Science and technology (S&T) cuts across national boundaries. Industry, a major beneficiary of S&T, has therefore can gain by integrating with the international S&T community. All countries seek to ensure that they derive maximum benefit from the globalization of science and technology. SMEs can also benefit from new process, techniques or new idea of production, improved marketing and management or accounting procedures that are developing around the world. SMEs with new technology may be able to overcome diseconomies of scale so as to compete with large enterprises. Many companies transfer technology to make their processes more global and diverse. Technology transfer has exhibited a positive effect on the exchange of information between companies and enhances their ability to adapt. However, these benefits will be best achieved only if the companies select the right technology and right strategy and understand the process of technology transfer and technology assessment.

To survive in this keenly competitive market SMEs must learn to monitor technological development actively. They must react quickly to relevant changes and renew and improve their products and processes regularly[5] in order to compete and prosper. But before getting involved in technology transfer or adaptation, they need to determine which technology they would like to receive from or jointly create with their partners or which technology they are willing to share with them to minimize the risk of adaptation. The task is very complicated and difficult and needs fine skills and judgment. It is difficult to determine the appropriate technology for one's company. This becomes more difficult because most of the parent companies seldom offer to share any core technology for strategic reason. Before any negotiation on technology transfer or adaptation, one must bear in mind that the appropriate technologies are those that match the needs of the receiving company or individual in terms of the transferee's level of knowledge, commitments, financial constraints, etc. Appropriate technologies are compatible with one's need for creativity.

4. TECHNOLOGY TRANSFER / DIFFUSION AND ITS GROWTH AND FALL

Technology spreads out across industries or countries through the process of technology transfer and technology diffusion. Technology transfer refers to the development of a technology in one setting before being transferred to another setting[6]. But technology diffusion is used to describe the spreading or use of a technology within a society, country, organization or group of individuals[7]. Thus, technology transfer tends to refer the producer of the technology while diffusion focuses principally on the end user of the technology[8].

Technology is man-made and is mostly produced in the research and development (R&D) organizations (within an enterprise or independent), mostly in the form of hardware or software. But out put of R&D organizations become technology only when they are used. Technology that exhibits a relative improvement in performance or cost over the older (established or conventional product or technology) eventually substitutes for the product or technology of lesser performance or higher cost[9]. Diffusion refers to the acceptance, over time, of some specific technology (product or know-how) by individual, group or organization[10]. Since new technology is better and economically more viable, after it has gained a small market share, it continues to grow its market share from the older one till eventually it takes over the major part of the available market.

Both use and efficiency of technology is growing exponentially. Many reasons can be cited for this[11]. Some of these are:

- Innovations breed innovation;
- Innovations all over the world are more and more pooled together as the barriers to communication are gradually reduced; and
- Methods of problem solving are improved at an accelerated pace.

New and effective technologies are pouring in every day as a result of stepped-up pace of innovation, substitution and diffusion. This in turn is accelerating the whole process of technological changes even more[12]. New machines and technologies are not merely products, but sources of fresh creative ideas. Each new hardware and software, in a sense, changes all existing technologies by permitting to put them together into new combinations.

Usually the growth of any particular technology conforms to an S-shaped curve, known as S-curve (fig-1) which, indicates the technology life cycle. Fig-1 shows each technology passes through an incubation phase where many ideas are reduced to one successful idea for introduction into the market. In the introduction phase the number of application of the new technology increases very slowly in the beginning. Later, when it starts increasing rapidly, the technology is in its growth phase. After some time, its growth is reduced and some stability can be observed in the maturity phase. Finally, an improved substitute makes the technology obsolete in its decline phase. Therefore, in any assessment for selection of technology, computation of its life cycle always comes into consideration to avoid risk of premature obsolescence.

Technology Life Cycle

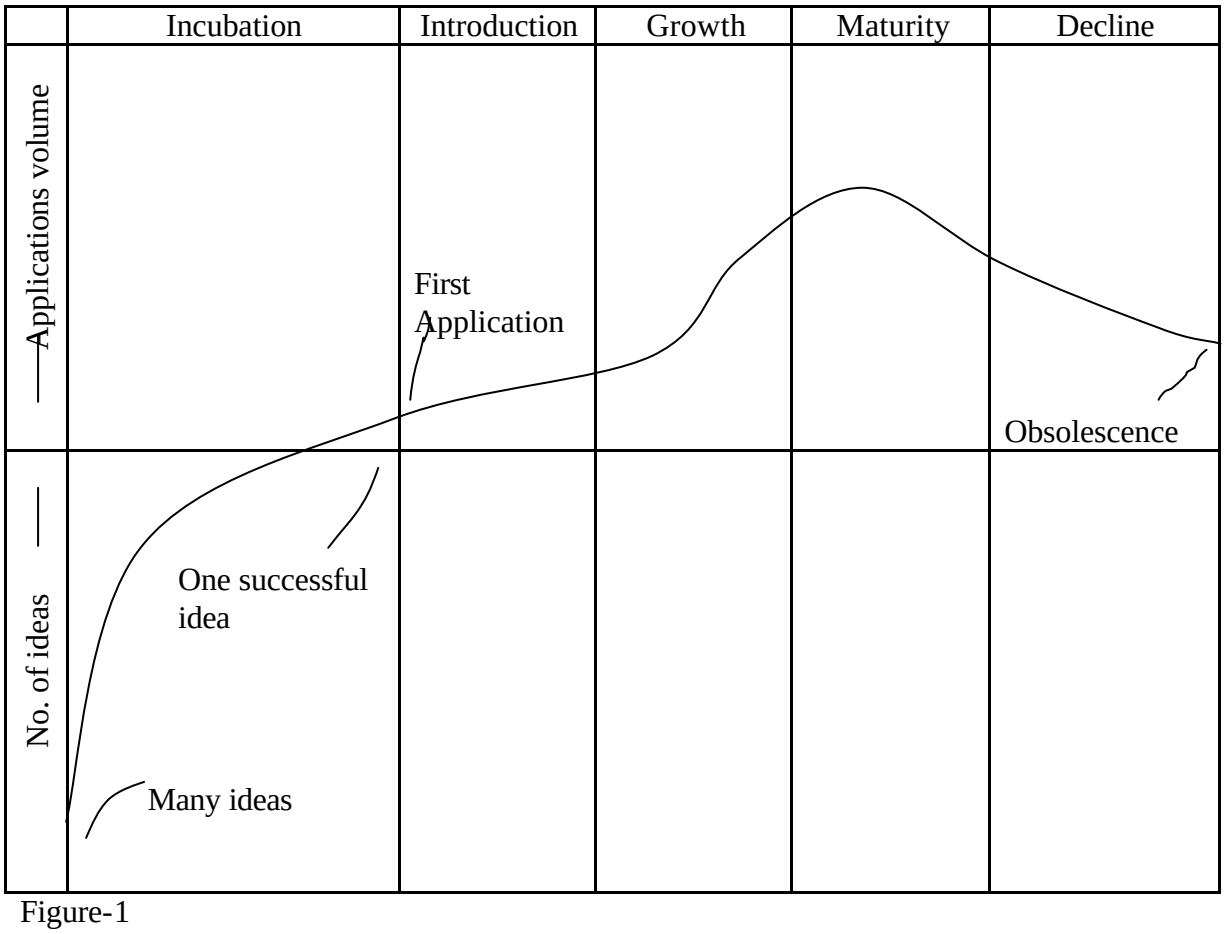


Figure-1

5. ADVANCED TECHNOLOGIES: WHEN THEY ARE APPROPRIATE FOR SMEs

The world is now passing through an exciting stage of technological progress. It is demonstrating an unprecedented potential, ranging from computer that think like human beings to nuclear fusion plants that produces electricity from ubiquitous substances extracted from sea water and recombinant DNA or genetic engineering leading to the birth of an entirely new industry in bio-technology that goes up to DNA biochips. Nano-technology, ICT and even Micro Electro Mechanical Systems (MEMs) are also very lucrative technological opportunities at the moment. These are emerging technologies, though very disruptive, are beginning to facilitate new product development in many different industries. Now not a day goes by without news of some seeming breakthrough in these areas of science and technology.

Advanced technologies have brought about changes in the manner of production. The mechanical engineering industry has been strongly revivified by the age of electronics to mechatronics, which now conditions the entire industrial system. The transition from mechanical engineering to mechatronics, is reflected by in-depth modification of the product, which is produced by this branch. Instead of offering machines it now delivers workshops or system of machines. The product-complex, which the mechatronics industry provides, is an assembly of four types of elements, these are:

- A system/or informatics for control, management and monitoring of the whole complex;
- An assembly of machining centres consisting of machine tools with a wide range of tools and able to work on parts with different characteristics;
- A system for conveying the parts from the entrance of the workshop, from machining centres to machining centres and thence to the exit from the workshop; and,
- An assembly of handling units for loading and unloading that is to say the interfaces between the conveying system and to machining centres and to the entry, exit or intermediate storage areas.

These machines are numerically controlled machine tools (NCMT). They act when they receive their instructions from computers, which programme and monitor their work. These machines have opened up a new manner of production system.

This remarkable trend in production process has not occurred without affecting the industry worldwide. It has caused a considerable impact on the organization of enterprises. The developing countries are affected by this trend in two ways, both as users and as producers. Since these are faster and more accurate, any enterprise should be willing to purchase them. But it is more likely that the enterprises in most of the developing countries may find themselves unable to purchase the electronic know-how locally in its effort to proceed from mechanics to mechatronics.

The production of these numerically controlled machines or rather workshops is a qualitative leap from the production of discrete machines. Such workshop shows hourly productivities of factories multiplied by many units, whilst the productivity per worker increases by a factor of more than ten. The lathe and machining center manufacturing plant (all numerically controlled), which Yamazaki[13] has installed at Minokamo, Japan is one of the finest contribution of the 'Mechatronics Valley', that prefigures the system of present day industrial strategy. Today, robots, CAD/CAM, etc. are available from various sources but it does not imply that automation in discrete engineering is easy.

The recent development in metallurgy and material science also has a profound impact on industrial and product development. New alloy and composite materials with amazing physical and electrical features and Nano-tubes and cylinders having wide range of use in industry are innovated everyday. Man is now able to manipulate the atomic configuration of metals and compounds to produce his desired objects to achieve results for their desired use.

BOX NO-1

For example, National Institute of Material Science (NIMS) in Japan announced the development of a technology to improve the ultra-violet (UV) luminescence efficiency of Zinc Oxide by 15 times or more. It is now being intensively examined for its potential as a light emitting diode. This Zinc Oxide is already named as low cost high function Phosphor. NIMS have also developed super conductive material produced from Magnesium diboride. Russian physicist professor Nikolay Ledentsov and his team at the Ioffe Physico-Technical Institute have developed a new technology of growing nano-materials: quantum dots grow themselves in the required order, without human help. Now laser crystals grow themselves. Scientists believe that laser on quantum dots will be widely used in industry. They already found its use in telecommunication, LED and in optical recording.

Apart from this, microelectronics is yet another means, which is having a profound impact on practically all sectors of industry and economy.
"Advances in IT, bio-technology and nano-technology can be expected to create an unprecedented wealth and opportunities for innovation. It is not only advances in within these 'triad' technologies, but their combination that are significant. The challenges for technology policy makers are to foster the exploitation of the emerging opportunities. Small and medium-sized enterprises (SMEs) have a special role as engine of societal change. That is why technology policy will have to create favourable conditions for innovation-driven SMEs specializing in high technology[14]." "Nations that will be able to foster the creation of SMEs that specialize in the 'triad' technologies will have a strong competitive position[15]."

The transition of high technology in traditional industries such as textile, metal, light engineering, etc. is undermining the competitiveness of the developing countries. The incorporation of functions previously performed by mechanical or electromechanical systems into electronic components are causing an increase in the packaging of technology into 'black boxes', making technology absorption and development more difficult for the knowledge have-nots. Therefore, the advanced technologies, though found appropriate for SMEs if they are to survive in the present global perspective, do not always find their usual place with SMEs in developing countries.

6. ASSESSING THE RIGHT TECHNOLOGY

SMEs must be able to assess technology. They must also be able to make choice between alternative technological means[16] in order to survive in the present global competition. This assessment and evolution of technology can be based on:

- The degree to which the technology will enable SME to meet or exceed the expectations of primary clients and customers;
- The ability of sufficient internal and/or external resources (financial/human) to acquire and implement the new technology;
- The degree to which the technology will increase the capability of SME to accomplish its strategic objectives;

- The degree to which the organizational culture will support the technology adoption and contribute to its success;
- The availability of either in-house or external expertise needed to integrate the technology with the existing technology;
- The SME's level of control over the use of, and profit generated by technology (through patent protection or a license agreement); and,
- The degree to which SME is culpable for liability issues surrounding the application of the new technology[17].

But SMEs usually cannot catch-up the new and effective technologies due to:

- Financial constrains;
- Lack of capabilities to monitor technology development;
- Lack of in-house R&D capability; and
- Unawareness of technology life cycle.

SMEs thus cannot obtain appropriate and correct information even they cannot utilize the information they already have. SMEs often select the cheapest or obsolete technology and means of technology transfer.

7. TECHNOLGY UPGRADATION NEEDS OF SMEs

Almost all SMEs are characterized by traditional or indigenous technologies. In the present global business context it has been observed that their existing production techniques and processes are dragging them to become uncompetitive. Therefore, SMEs need to harness technology appropriate to them to enhance their national and international competitiveness. With technology-based innovation playing an increasingly important role in developing global niche markets and opportunities, the old modes of technology transfer and diffusion have had to evolve in new and more effective ways. If the production process or technology is indigenous, imported technology or expertise may not support SMEs in achieving the desired results.

SMEs face serious constraints in acquiring new and appropriate technology. Thus many governments around the world are taking up various programmes to support SMEs, particularly in the field of technology development or diffusion and in their efforts to find out market opportunities and advantages. Many governments are also supporting their national R&D institutes and universities in conducting expanded activities to work with innovative SMEs and seeking international collaborations in necessary fields.

SMEs are facing many challenges in the age of market and trade globalization. They therefore, need to strengthen their technological base to make themselves competitive, so as to create a niche for themselves. The opportunities are immense if they can upgrade their capabilities to catch up the modern techniques of management, production and marketing. SMEs occupy an important place in developing countries as they contribute significantly to their wealth and employment, as immediate and final producers and as consumers of goods and services. New entrepreneurs through their entry into SMEs continuously generate ideas, skill and innovations to enrich them further.

A strong SME sector in a country can attract and enable foreign investors to establish and expand domestic linkages. SMEs can stimulate the growth of numerous indigenous enterprises with wide regional dispersal. But because of their size, however SMEs are less

resilient to risk, which prevent them from attaining economic scale. These limitations are particularly significant in the area of human resource development and access to technology and information.

SMEs face serious difficulties arising from the adjustments they have to undertake in the face of the liberalization and globalization of markets. They are also facing difficulties in their transition to high technology from traditional processes after the introduction of more precise, faster and less power hungry technologies like numerically controlled machines, CAD/CAM, and other all-pervasive microelectronic devices. They therefore need enhanced supports both domestically and internationally. This support is essential in order to harness opportunities originating from the globalization of trade and investment and to cope up with the rapidly changing technologies.

In the present fast-changing business environment distinction between domestic and foreign markets is becoming irrelevant. The 'level playing field' offers opportunities as well as challenges to all in business and especially SMEs. This has brought opportunities to SMEs because they can sell and invest more even across the borders of their own country to earn more. This opportunity in turns brought competition for SMEs in their expanded markets. Apart from competition the changes in the customer needs and preferences are driving them to innovate or upgrade products and services to cater to the ever-changing taste and needs of the market.

SMEs will therefore, have to improve their products and services, evolve marketing strategies and develop new technologies in order to remain competitive and stay at the leading edge of technology. Thus, technology and its management have become the best way of ensuring a competitive advantage in the global business on a 'level playing field'.

To face the new challenges, the developing countries have to drastically restructure their strategic plans, develop the skill needed and build new structures in order to survive and thrive. While each nation charts its own road map based on its resources and culture, there is now the imperative for all to acquire, assimilate and apply proven technologies and move from imitation to innovation. In this difficult task all players, governments, R&D institutions, universities, organizations, other learning systems and businesses have clear responsibilities.

8. TECHNOLOGY MANAGEMENT FOR ITS NECESSARY UPGRADATION, TRANSFER, ABSORPTION AND DIFFUSION.

The world technological and industrial transformation is causing practically all countries to aim at modernizing their industrial production apparatus, in order to keep pace with the needs of globalization. The developing countries, therefore should seriously ponder on the following issues:

8.1 Impact of the Diffusion of Modern/ Electronic Technology

- All industrial sectors are concerned, in terms of either of production, processes (automation) or of products incorporating ever more automation/electronics. The developing countries should pay attention to these developments and consider their consequences so that proper ways and means can be evolved to face the challenges.
- The automation occurring in the industrialized countries are progressively undermining the favourable position once won by the developing countries in certain sectors of the world market. This is particularly very prominent in sectors like

clothing industry, mechanical industry, automobile and its spare parts, electronic component manufacturing, machine tools and electronic industry.

8.2 Choice Between Conventional Processes and Automated Processes

Here the decisions should be made gradually, taking the following points into simultaneous consideration.

- The advantages offered by automation as regards improvement of productivity and quality;
- The implication in terms of maintenance and repair of the new equipment installed;
- The position of the sector in question against the background of international competition. Automation should start with those sectors, which are the most exposed to competition (on the local or world market) and those in which national production is not sufficient to meet local demands; and,
- The possibility of simultaneously shaping their production structure in the way, which will be necessary in order to meet the technological challenges of the present global competition.

8.3 Socio-economic Adjustment

Modernization and automation in industry may reduce the number of work places in an enterprise. But this may happen without necessarily lowering employment at the firm level. Most of the studies conducted in industrialized countries show that the macro-economic results are not negative. This does not mean that these results are spontaneous. Rather it indicates that supporting policies of institutional and financial nature are necessary in order to facilitate the reorganization of the socio-economic systems.

Modernization needs reorganization of operations in the widest sense, within the enterprise. The skill required for former jobs are modified, others disappear altogether and new ones become necessary. The old kinds of know-how may no longer suitable or must be combined with others, which may be available in the enterprise with which co-operation must be pursued. In addition, the necessary intra-enterprise co-operation on the part of workers and a display of interest in the organization of the work in progress seem to play more important roles than formerly[18]. Here actually we are faced with a new concept of labour, which calls for substantial socio-economic adjustments characterized by greater job flexibilities and greater worker participation. Modernization of technologies will require among others the followings:

- Training;
- Repair and maintenance capability development;
- Regional and international co-operation; and,
- Relocation and FDI as strategy.

These are some of the major factors that need special attention for fostering technology development in any developing country like Bangladesh.

8.4 Technology Management

Management of SMEs should conduct analysis in order to determine appropriate technology and in case of technology transfer, appropriate partner. SMEs need to integrate technology transfer into their overall strategy and the management should commit itself to technology

up-gradation and transfer whenever necessary. Technology management at operational level is one of the most important activities, which SMEs must attach due emphasis as in most of the cases it will be found that SMEs have to select appropriate modern technology or processes in order to be competitive in the market. Of course, with contract-based technology transfer, no significant change in the company is necessary. Only the company has to monitor whether or not the partner breaches the contract. But if the company is the buyer of technology, it just needs to use the technology it bought to improve its operation and product development without violating the agreement. It may need to make other social adjustments as has been discussed before.

When technology alliance is made (for any embedded technology), there are many changes required in the company, though the extent of changes necessary will depend on the type of technology alliance (a brief on technology alliance and contract-based technology is given in Box No-2). It may affect either certain departments or the entire company. Even the company may fall in a great uncertainty and various control problems may occur because of the changes or state of dissemblance prior to full operation of the future state. To solve these problems, managers need to follow the four areas of actions that David and Michael suggested[19], are:

8.4.1. Develop and communicate a clear image of the future state:

- Complete a design of the future state;
- Construct a statement that identifies the impact of the change on different parts of the company;
- Maintain a clear vision and avoid unnecessary changes during transition; and
- Continue to communicate through various media including group discussion and meetings. Explain rationale of changes and the advantages in future.

8.4.2. Use multiple and consistent leverage points for changing behaviour:

- Determine and modify the work including informal arrangements; and
- Monitor and/or predict some of the poor fits that may occur when changing any of the organizational components.

8.4.3. Use transition devices, comprising:

- A transition manager;
- Specific transition structure such as dual management systems and back-up support;
- Specific transition resource, including budget, time and staff; and
- A transition plan.

8.4.4. Obtain feedback and an evolution of the transition through:

- Formal methods: individual interview, various types of focus-group data collection, surveys used globally or within selected samples, or feedback gathered during a normal business meeting;
- Informal channels: senior manager's meetings with individuals or with group, informal contacts or field trips; and
- Direct participation by representatives of key groups in planning, monitoring or implementing the changes.

To implement these ideas management's commitment and leadership are essential. Management should devote its full efforts towards improvement in operation and creation of innovation through new technology and knowledge. It should incorporate the technology strategy into the objectives of the whole firm. It also should tie the performance of its employees with the improvement resulting from the new technology. This is also done to motivate the employees. Actually, the company should closely manage and monitor the process and consequences of new technology bought or transferred.

BOX NO.-2 - CONTRACT-BASED TRANSFER AND STRATEGIC ALLIANCE [20]

Contract-based transfer can be in the forms of export of hardware, use of license for proprietary technology or rights, technical assistance contract, contract manufacturing with technical assistance, management contract, training contracts, architectural and engineering contracts, R&D contracts, construction and supervision contract, turnkey contracts, turnkey-plus contracts, production sharing and cooperation. Under this system, companies may acquire the specific knowledge and technology only as specified in the contract. The level of interaction is also limited to a certain period of time only. Unless the transferee companies have the capability to reverse-engineer for further develop new knowledge from the existing one, technology development will cease.

Currently, the trend in transfer of technology is predominantly moving towards strategic alliance, such as joint ventures, partnering, mergers and acquisitions. Alliances may be most useful at the cutting edge of the learning agenda, to access and internationalize technologies and know-how that are embedded, largely tacit, uncodified, and thus difficult to access via contractual approaches that do not involve a close collaboration between the partners.

9. INTERNATIONAL EXPERIENCE

9.1 TECHNOLOGY ABSORPTION CAPACITY DEVELOPMENT EFFORTS

SMEs all over the world increasingly need flexible and innovative drive on improved production methods, penetrating marketing strategies and modern scientific management capabilities to sustain and strengthen their operations. They should be poised for global partnership and have the potential to transfer or absorb latest technologies in diverse industrial fields.

The purpose of technology transfer of SMEs should be to reduce R&D cost and speed up product development and penetrate into new markets where they might get advantage over the others. Such technology transfer of SMEs can occur at both domestic and international levels. Due to their inherent limitations, SMEs usually form their partnership with small companies, government agencies and suppliers. But depending on their size, capacity and management network some SMEs may venture beyond their national boundary.

In general technology transfer may occur in four ways:

- Within an organization;
- Across industries;
- Across companies within the same industry; and
- From institutions or government agencies to the organization.

But most SMEs need modernization to be able to acquire and adapt any new and emerging technology. In the changed business perspective many governments around the world have started to view SMEs as the driving force of the economy. They, therefore, are increasing their support and collaboration with SMEs for improving their technological skill and capabilities and also acquainting them with modern manufacturing process and hardware. Small And Medium Enterprise Administration in (SMEA) in Taiwan supports all university related incubators in order to help develop SMEs using the existing R&D capability of the universities[21]. This is a unique example of government supporting technology for SMEs.

Similarly, the government of India has developed the city of Bangalore to be the IT hub in order to promote the IT sector, as a part of its economic reform programme. India is also continuously developing and modernizing all its engineering and technology institutes. They have already developed Bangalore with IT cluster combined with ideal living conditions where the majority of the software companies are located now[22]. In India, SME development has been pursued consistently since the 1970s. Several institutes were created during this long period to support this sector. Today 40% of India's total industrial output comes from this sector and 35% of its export depends on SMEs. Small-scale industries (SSIs) has been given the due attention and care for its upgradation and modernization. Since 1996 the government of India redefined SSIs in terms of investment to accommodate the modernization needs, which require higher capitalization. According to this new definition:

- A production unit is considered as small if it has an investment of $ 30 million; and,
- Production units ancillary to large scale units are considered small if they sell not less than 50 percent of their manufactured products to one or more industrial units.

By this way they allowed comparably bigger (than before) and greater numbers of industries to enjoy facilities offered by large number of institutions spread all over the country. These institutions and agencies are devoted to promote SSIs, which include DFIs, technological research centres, training institutes, technical assistance centres etc. India expects to generate a growth rate of 12% in the current Five Year Plan 2002-07 from the SSI sector alone. So far SMEs in India has achieved the higher growth rate compared to other industrial sector's growth rate. It is true that the vast domestic market in India has been an added advantage for SMEs there.

In Pakistan SMEs have been contributing to its national economy greatly. More than 30% of the GDP comes from this sector and about 70% of the total employment has been generated by SMEs. Recently the government has attached priority for the development of SMEs and enhancement of investment has been suggested as a strategy for the development of the sector. Pakistan Industrial and Technical Assistance Centre (PITAC) and Pakistan Council of Scientific and Industrial Research (PCSIR) have been contributing greatly towards the country's industrial development.

Sri Lanka has created a number of facilities through its Industrial Development Board (IDB), Ministry of Industry and Development, to upgrade their technological level. For example, it has established Casting Technology Improvement Project for training in molding, melting, modeling, inspection, etc., to support local industries. The project is contributing greatly to upgrade the skill in foundry technology and also encouraging the local entrepreneurs of SMEs to acquire modern machinery and equipment.

Most of the Asia-Pacific Economic Cooperation (APEC) economies have adopted supportive policies for SMEs. They have provided due emphasis on technology and human resource development (HRD) aiming at making SMEs more competitive. This may be seen from the programme-wise budget allocation (Table 1&2) of APEC member economies. Tables 1&2 show that three main areas covered by the budget is finance, technology and HRD.

Allocation pattern on Table 2 shows that a number of countries have allocated more assistance toward technology and HRD. This is quite judicious because once technology and HRD have been achieved and upgraded to an acceptable level the next requirement is finance.

Apart from this there seems to be a considerable increase (of about five times) in allocation per SME during 2000-01 than in 1994-95. This increase obviously has been made on the results that had been achieved out of financing technology and HRD during 1994-95.

Table 1: SME Programme Budget Comparison, 1994-95 and 2000-01

Country	1994-95		2000-01	
	Nominated budget in million USD	Budget per SME in USD	Nominated budget in millions USD	Budget per SME in USD
Australia	304.82	402.62	1300.00	1169.27
China	0.41	0.05		
Hong Kong, China	301.33	1084.38	1002.00	3431.69
Indonesia	1.81	0.15		
Japan	950.80	146.63	289.00	47.13
Korea	2070.60	988.52	856.00	317.15
Malaysia	0.01	0.00		
Singapore	3.93	124.87		
Chinese Taipei	28.80	36.38	1095.00	1042.50
Thailand	0.80	12.66		
Average		265.54		762.01
Average 2010		285.10		907.61
Average 2020		238.15		179.59

Source: Bangladesh Enterprise Institute; Taking stock of charting a path for SMEs in Bangladesh. 2004. p.17.

Table 2: Comparison of Budget Allocations by Main Programme Areas

Country	Percentage of Funds Allocated to Each Area											
	Information Access		Finance		Technology		HRD		Market Access		Women and Admin Burden	
	1994-95	2000-01	1994-95	2000-01	1994-95	2000-01	1994-95	2000-01	1994-95	2000-01	1994-95	2000-01
Australia	0.5	0.0	63.3	0.0	10.6	96.1	25.7	0.3	0.0	3.5	0.0	0.1
China	0.0		0.0		57.1		42.9		0.0		0.0	
Hong Kong, China	0.0	0.0	0.0	73.0	11.4	19.3	88.6	7.7	0.0	0.0	0.0	0.0
Indonesia	0.0		76.9		23.1		0.0		0.0		0.0	
Japan	0.0	2.1	0.0	1.0	95.8	3.5	4.2	41.2	0.0	52.3	0.0	0.0

Korea	0.0	3.4	66.8	87.4	22.6	8.2	1.0	1.0	9.6	0.0	0.0	0.0
Malaysia	0.0		0.0		0.0		0.0		100.0		0.0	
Singapore	0.0		0.0		16.7		83.3		0.0		0.0	
Chinese Taipei	0.0	0.0	45.9	87.4	39.2	10.2	14.8	2.3	0.0	0.1	0.0	0.0
Thailand	0.0		0.0		0.0		13.2		86.8		0.0	
Average	1.2	0.9	28.0	51.4	28.8	19.9	28.3	10.8	13.1	15.7	0.7	1.4
Average 2010	1.2	0.5	23.1	46.8	41.2	21.3	33.4	12.0	0.0	17.7	1.2	1.6
Average 2020	1.3	3.4	33.6	87.4	14.7	8.2	22.4	1.0	28.1	0.0	0.0	0.0

Source: Bangladesh Enterprise Institute; Taking stock and charting a path for SMEs in Bangladesh, 2004, p. 18.

In Thailand a premier R&D institution, The Thailand Institute of Science and Technological Research (TISTR) has been very active in transferring technologies developed from its R&D activities to industries. TISTR as one of its policy guideline is committed to cooperate with the industrial sector in R&D in order to benefit the country in commerce, especially SMEs. It renders training and consultancy service to SMEs.

Also in Thailand a project has been launched called SIC- Tool and Molding Technology Development project under Bureau of Supporting Industry Development, Ministry of Industry. This project is working for improving the quality of technical training and providing other supports for producing molds for plastic injection industry. The same ministry in Thailand through its Metalworking and Machine Industries Development Institute has started a project named as Thailand Metal Processing and Machine Industry Development and Promotion Centre to help improve the quality of casting, heat treatment, material testing, etc. in SMEs.

In Hong Kong, The Hong Kong University of Science & Technology (HKUST) has structured its R&D branch to assist in activity from basic and fundamental research to commercialization and business development. Its Technology Transfer Centre (TTC) has the following objectives:

- Assist faculty in developing industry- sponsored research;
- Help industry to identify R&D capabilities relevant to their needs;
- Form R&D partnership/consortia with industries and government agencies;
- Review and protect intellectual property having commercial potential; and,
- Promote technology results and capabilities developed by the University.

HKUST R&D Corporation Ltd (RDC) is a separately incorporated company that is wholly owned by HKUST. It serves the business arm of the university, focusing on commercial aspects of research out put, which includes financial administering of contracts, consulting agreements for use of university facilities, technology transfer and licensing agreement, management of incubation facility, management of venture capital and funds and assistance for start-up companies.

Also in Hong Kong, Technical Education and Industrial Development Centre, a project for the development of the precision sheet metal pressing technology, offers die technology training and other supports to SMEs for precision metal stamping.

Australian Academy of Technological Science and Engineering (ATSE), in Australia is an internationally reputed organization. It links with global S&T research and development. ATSE Fellows are S&T leaders who work in industry, government, universities and research institutions. One of the major activities of ATSE is its programme for knowledge transfer

those are important for SMEs and improve Australia's access to global S&T through fostering global linkages. They have already developed multilateral links with almost all the developed and developing countries of the world.

In the 1980s, after analyzing global competitiveness, technology trends and future markets, Taiwan focused on a few carefully selected technologies. Major considerations were population issues, high value-addition, low energy dependence etc, which could make Taiwan an example to developing countries. But with the rapid development of high-tech and knowledge-based industry, they began to experience that the success in a high-tech venture depends on:

- Well defined core technology;
- Highly trained engineers; and,
- Pilot plant experience.

Therefore, to reduce R&D cost of the enterprises, Taiwan established government-supported university-based incubators. Now in Taiwan many high-tech ventures are slices of a major enterprise. In truth, these ventures could be considered high-tech service industries and they are deliberately becoming small. Small and Medium Enterprise Administration (SMEA) is assigned to support such activities/programme. One of the major objectives is to set up a comprehensive mechanism of knowledge innovation and technology transfer to enhance the competitive ability of SMEs.

China has embarked on a successful strategy for the promotion of technology innovation and transfer. She has strengthened technology transfer information services in order to facilitate the commercialization of new innovations. The mechanism involves the promotion of networking among intermediate service organization such as technology innovation service organizations, technology assessment organization, technology agents and technology information consultancy service organizations. Such intermediaries have been given guidance by framing laws and policies in providing effective services to accelerate the transfer of S&T achievements. Information Consultancy Service Organizations provide enterprises, especially the vast number of SMEs, with services in the fields of management, technology, marketing, information, skilled personnel, financial affairs, banking and law. These are non-profit organizations. Since the early 1990s, about 700 Productivity Promotion Centres (PPCs) have been established nationwide. The main task of PPCs is to provide training to SMEs on modern management and quality control, business incubation, technical consulting and services. PPCs provide assistance to SMEs to adopt appropriate technologies and also to extend business abroad. As government-supported agencies, PPCs play a bridging role between government and research institutes and SMEs. In 1999, the central government decided to set up a special innovation fund to support the development of technology driven SMEs. They could reach SMEs by way of appropriation, loan interest subsidy and equity investment. Nearly 80% of SMEs that received support from the innovation fund have shown great dynamism and high potential to contribute more and more to the national revenue. Their products became export worthy to earn hard currency.

In Korea, the Small & Medium Industry Promotion Corporation (SMIPC) has launched a modernization programme for SMEs in Korea. The SMIPC is a non-profit organization of the government, established in accordance with the small and medium industry promotion law of Korea. The Corporation is implementing various programmes for the promotion of SMEs. These programmes include financial assistance, extension service, training service, information service and so forth. In accordance with the Special Measures Act for the Promotion of Operational Stability and Structural Adjustment of Small and Medium

Enterprise, SMIPC is also conducting technology development and modernization programmes in SMEs. SMIPC derives its financial resources mainly from the government budgetary sources.

Also in Korea, University Industrial Technology Forces (UNITEF), as a non-profit corporation was organized by 570 engineering professors from universities all over the country in 1996 to build up SME trust in university research (for further information visit the UNITEF home page at www. unitef. com.). UNITEF has been mainly executing its Trouble shooting Aid for SMEs (TAS) programme based on excellent technologies embodied in universities. It has also undertaken a university-to-Private Technology Transfer Support (UPTTS) programme sponsored by the Ministry of Commerce, Industry and Energy (MOCIE) and the Technology Evolution Support (TES) programme. TAS promotes cooperation and exchange between university and SMEs. It provides technical assistance to SMEs free of charge initially and charges fees only when it is found to be successful. UPTTS, which began in 2000 aims to support excellent research outcomes from universities by providing follow-up funds for further development and commercialization. In addition, TES supports the evaluation task on behalf of government agencies, public agencies and banks while evaluating R&D projects, new technologies and technology based business. For more information and contact for technology transfer the list of government funded research institutes in Korea, Annexure- 1 may be seen.
A modern casting center named as Marcelino Corradi Foundry Technology Centre has been established in Itaura, Minas Gerais in Brazil by its government. The project is providing training and technical support to SMEs to help improve the quality of their foundry products.

In Philippines, the Metal Industry Research and Development Centre (MIRDC) under Ministry of Science and Engineering has established Plastic Molding Tool Technology project to provide technical support and training to SMEs.

In Canada, the National Research Council (NRC) works closely with innovative SMEs on international collaboration. Their programme covers a number of government instruments and focuses directly on technology and innovation. With more than 20 research institutes and technology centres across Canada NCR has a diverse knowledge base, linkages in key areas of the knowledge economy and access to foreign research institutions and government agencies that also have knowledge or a responsibility to promote industrial innovation. In addition to these NRC facilities, it's Industrial Research Assistance Programme (IRAP) established linkage with over 12,000 Canadian SMEs every year. IRAP has a network of more than 140 technology-base organizations such as universities, private research centres, and provincial research organization. Further NRC is responsible for Canada's S&T information and delivers more than 4,000 documents a day to clients around the world; 57% of these documents are delivered to industries. Three types of players are seeking international collaborations and their mutual interactions from Canadian perspective are:

- Government laboratories, universities and research organizations are interested in international collaborations, to benchmark R&D activities, as well as to access and create new knowledge with a view to developing Canada's economy.
- Canadian firms are looking for strategic information, technologies and market share and revenues; and,
- In a reciprocal manner, international partners are also looking at Canada for similar access to technologies, knowledge and markets.

NRC's has developed a range of collaborative mechanisms, which includes among others.

- Scientific exchange programme;
- Scientific visits to and from Canada;
- Formal collaborative research projects with international organizations and partners both in Canada and abroad; and,
- Technology mission to and from Canada with groups of NRC scientists and SMEs to meet their counterpart abroad. This is necessary before undertaking a preliminary matching of the SMEs on each side.

In Canada, over 97% (or over two million firms) of the total industrial sector consists of SMEs. As in many other countries, these SMEs have little time or money to conduct R&D or to try to access technology even in their own government laboratories or in universities, unless the government gives them the necessary assistance. The governments therefore set up and deliver programmes to assist SMEs in technological innovation, based on accessing, assessing, adopting and adapting local and international sources. Industrial Research Assistance Programme (IRAP) in Canada therefore, has been working with an aim to help stimulate technological innovation and build technical capability in SMEs. IRAP encourages firms to make visits abroad to assess and access appropriate technologies, and where appropriate, to set up mutual collaborations.

As a result of globalization and the growing importance of knowledge-based economies, there is an increasing need to focus towards innovation practice and adopting improved mechanisms to enhance innovation capability through international collaborations. NRC believes that through linking of core research institutions in partner countries with their SME communities, effective synergies will occur. This in turn, will offer developing countries a cost-effective strategy to develop their technology-based innovation system, which may also help induce FDI from large multinational technology-driven subsidiaries.

In the USA, an agency, Small Business Administration (SBA) under the US Federal Government has been at work to counsel, aid, assist and protect the interest of small business enterprises in the USA. They administer the Small Business Development Centres (SBDCs), which are sponsored by lead organizations that coordinate services offered to small businesses through a network of sub-centres. These sub-centres are located at chambers of commerce, economic development corporations, universities, colleges, vocational schools and community colleges. Its other objectives are:

- To render management assistance to current and prospective small business owners;
- To offer one-stop service to small business in the form of information and guidance from central and other branch locations;
- To provide counseling, training and technical assistance in all related areas of small business management; and
- To reach minority members of socially and economically disadvantaged groups, old men and women and disabled persons.

In Europe, the Euro Info Centres (EIC) have been established to inform, assist and advice the great variety of SMEs in Europe. EIC receives the queries from SMEs directly to meet their needs. They publish and distribute technology guides and news bulletins, organize seminars, etc and many of them have their own websites. They also help SMEs in their search for partners and on business low matters. They advice SMEs on the procedures that are required to be followed in any business deal with European institutions. The European Community Research and Development Information Service have been engaged in assisting SMEs with wide range of services. It helps them with up to date information on technology transfer, R&D and innovation activities in Europe. Since 1995, Information Relay Centres (IRCs)

have been working as a network in Europe for the promotion of technology partnerships transfer among SMEs.

Besides these direct assistance programmes for upgrading SMEs in their ability to absorb appropriate and modern technology, there are some indirect means available from which the SMEs may take advantages. There are professional publications like Asia Pacific Tech Monitor, a bimonthly of Asian and Pacific Centre for Transfer of Technology (APCTT) those contain technology offers from the intending companies around the world. The Internet also has several websites such as government websites that provide technology transfer offers. Websites of the universities and other Internet sources also contain technology offers. The United Nations Industrial Development Organization (UNIDO) has a programme to support the developing country with technical assistance, training, exchange of information; investment promotion and technology transfer for a harmonious and balanced industrialization. World Bank also has assistance programme on Technology and related fields. Any group, individual or SMEs may also seek assistances from these worldwide sources.

9.2 CURRENT TREND IN TECHNOLOGY MARKETING

The globalization of technologies and the competitiveness of firms are complementary. As advanced technology-intensive activities are growing faster than less technology-intensive activities, new innovations are contributing towards change in the characteristics of technology transfer. The increased technology intensity of products reduces the importance of primary and simple low-technology activities, raising the skill intensive activities. A firm can, therefore, take advantage of different economies around the world, so that each activity is located in the economy where that activity can best be performed. This is the key concept of comparative advantage-based competitive advantage.

Globally integrated production systems with its location of activities in appropriate host economies are significantly enhancing competitive advantages. In this way, the global industrial structure is becoming more and more competitive and efficient. The firms in the host economies engaged in carrying out these activities are mostly SMEs. They coordinate or share these activities in the value chain, or involve products that are complementary to the firms of other economies.

For example, in Bangalore, India, competitive software companies, mostly SMEs, with its pool of highly skilled engineers have attracted the multinational firms to transfer technologies for mutual benefits. World famous IT cluster like Silicon Valley in California, USA; Silicon Fen in Cambridge, UK and Wireless Valley in Stockholm, Sweden are harnessing advantages by globalization of advanced technologies.

Since all products including technology follows a life cycle of its own, they go through a product cycle of introduction, growth, maturity and decline. Thus, comparative advantage in the production of these goods shifts one economy to another, over time. For any product, as the market matures in developed economies, price becomes the main competitive factor. At this stage the advantage of production shifts to less developed economies to take advantage of cheap labour. Therefore, the multinational firms are now dispersing their value chain activities across different economies. In order to effectively conduct these activities, the firms have to transfer the necessary technology to host economies. This technology transfer, or globalization of technologies enhances the competitiveness of the investing firms. SMEs of the host economies are also taking advantage of this globalization trend.

Some innovations create competitive advantage by opening an entirely new market opportunity. For example, new information and communication technologies intensified competition while allowing firms to manage widely dispersed international operations. In China, foreign firms do not just transferred technologies to Chinese workers but also established R&D centres there. The process, therefore, is developing and deepening regional clusters of related and supporting sector firms, mostly SMEs in China.

Multinational firms, such a Nokia, Microsoft, GM, Motorola and Samsung have established more than 100 R&D Centres in China. Only Microsoft has already invested $ 80 million in Chinese research institutes and announced $ 50 million more to create a Microsoft Asian Technology Centre in Shanghai, China (UNCTAD 2001). The Chinese government, keeping in line with this development, has introduced policy measures to reform its science and technology system, promoting self-sustained and market oriented research institutes.

Taking advantage of globalization, the foreign firms are enhancing the quality of the business in China. The process has improved the business strategy and structure and more domestic firms are crowded in improving the market structure. For example, (UNCTAD2001) Motorola, one of China's largest foreign investors since 1987, with a stake of more than $ 3.4 billion, has established two wholly owned affiliates, 8 joint ventures and 18 R&D centres in China. Local firms that become certified suppliers to Motorola, continue to receive various types of supports in order to remain qualified. By the end of 2001 the number of these local suppliers, mostly SMEs has exceeded 1000.

The role of foreign direct investment (FDI) is now seen as an instrument to bring about globalization of technologies for the benefit of SMEs. FDI has been successfully adopted worldwide to catalyze transfer and globalization of technologies. But a firm's ability to catalyze globalization of its technologies through FDI depends on many competitive factors.

The host economies are now seeking more FDI for their long-term economic development[23]. They also seek other benefits like technology transfer, market access, linkage and spillovers to other fields and enhanced industry structure of the host economy.

If foreign firms can procure its inputs locally at a lower cost in addition to already available lower labour cost, they will be in a position to greatly cut down their production cost. Therefore, investing firms are more likely to transfer technology to local SMEs for production of those inputs. Thus, technologies that were once out of reach of less developed economies can now available and be acquired in this way. In addition to production technologies, managerial and organizational skills are also transferred. The process in turns increases the recipient's (mostly local SMEs) marginal productivity of capital invested and then raises output and employment in host economy. But for this to occur more effectively, local workers and firms have to continue to upgrade their capacity to absorb new and high technologies[24].

In recent times R&D has been one of the basic driving forces for the quick growth of industry and business. R&D institutions, universities and industries have also been cooperating more closely than ever before. This silent revolution has been taking place and intensifying more with the advent of the new knowledge revolution. This has gained universal prominence in the 1990s. In this respect, we may recount two very interesting developments in R&D practices, which laid the way for such revolution. The first has been the rise of academic entrepreneurs in the USA since the 1970s with the growth of knowledge enterprises in places like Silicon Valley and Route 128 in Massachusetts, which were than followed in other places in the USA and elsewhere in the world. The second development is the changing

pattern in academic and industrial interaction on R&D. The evolution of these developments got momentum during the 1990s and the wealth generating potential of R&D began to earn recognition and high degree of acceptance. Now the pivotal role of R&D in economic development and business growth has become prominent, transparent and much sought after. R&D as a business is a new reality for creating wealth and employment and any developing country including Bangladesh cannot be an exception to these phenomena. Therefore, to keep up with this trend of technology development and business, modernization of laboratories in the R&D organizations and universities supported by groups of devoted scientists and engineers and necessary funds with a well-defined policy supportive to catalyze the process/phenomenon must be made to achieve this effective and cheapest way for profitable R&D activities.

The advent of the Internet has led to a proliferation of website devoted to the marketing and licensing of innovation from universities, R&D organizations and companies. There are already a good number of Intellectual Property Portals (IPPs) identified as websites created specially for the purpose of marketing intellectual property. During the 1990s, intellectual property also experienced a rise in value. For example, in 1997 the total stock market value of all publicly traded US companies was about $ 7 trillion but the book value was only about $ 2.3 trillion, or about one third of the total stock market value. IPPs are though a new addition, are a very useful media for technology transfer community. They represent a step forward towards the globalization of the economy by broadening access to new technologies. In Annexure-2 a list of technologies and buyers with their market segments has been shown in a table form.

10. TECHNOLOGY STATUS OF SMEs IN BANGLADESH

The SMEs in Bangladesh is predominantly characterized by indigenous and traditional technology. The source of technology of these SMEs varies from firm to firm. Some firms point to previous experience as their source of technology, for others it may be the suppliers who introduced their present technology, some will be found who developed workshop/firms as subcontractors according to their buyer's needs. The source of technology and its type also seems to follow something of an industry pattern[25]. For instance, there is a tendency of SMEs in light engineering to mention previous experience or 'imitation' as the most important source of technology. In apparel, particularly in embroidery and level printing, where technology is more sophisticated, firms point to machinery suppliers. SMEs in food, pharmaceuticals and electronics on the other hand use mixed technologies, both indigenous and sophisticated. The subcontractors use mostly the indigenous and traditional technology in the absence of provision of licensing agreement between buyers and sellers.

In Bangladesh subcontracting linkage between large and medium enterprises and small industries has been officially in practice since 1st October 1989 with the issuance of a government gazette notification (No. Shilpa/Sha-sa-3/Par-11/88/255). Subcontracting arrangement has been universally accepted as a means of industrial development, which help reduce the cost of production to a great deal. The finished products usually consist of various parts and components. The cost of establishing separate manufacturing units for some of these components does not always justify themselves. Thus it is more desirable to establish subcontracting arrangements with independent units capable of producing those components. This type of arrangement thus helps reduce management problems of the large industries/buyers to a great extent. In addition, subcontractors by specializing themselves in the production of a few components can achieve greater production efficiency and can fully utilize their plant capacity and labour forces. They can thus maintain lower price of the

product and enhance their technological capability. The buyer/ parent industries may establish subcontracting linkage with these smaller units in the area of:

- Making spare parts (as replacement item for repair works or s items of batch production).
- Making and installing capital machinery.
- Service providing for a segment in the manufacturing chain or service chain.

But the above government gazette provided facilities for only a limited area of possible subcontracting arrangement. It only provided such facilities for small manufacturer of machinery and spares made from metal, plastic, ceramic etc. So far the major buyers are in Government sectors and about 1200 subcontracting units have been identified as possible subcontractors through out the country. They are now linked with nearly two hundred government buyer agencies and industries. About 4000 subcontracting linkages have been established among those subcontracting units and buyers. These numbers are also increasing gradually at a reasonable rate. Bangladesh Small and Cottage Industries Corporation (BSCIC) has been entrusted with the task of implementing the subcontracting programme provided by the above gazette notification and thus BSCIC has been working as a pivot for subcontracting activity in the country. These subcontracting units so far have been able to produce the following number of spares and machinery in the country:

Sl. No.	Sub-sector	Number (types) of spares
1	Automobile	200
2	Railway and locomotive	600
3	Bicycle and paddled rickshaw	50
4	Machine tools	100
5	Jute and textile	550
6	Sugar and food industries	200
7	Engineering	800
8	Ship building	160
9	Pharmaceutical industry	50
10	Agriculture	100
11	Gas line fittings	15
12	Electrical & Electronics	400
13	Chemical industries	550
14	Telecommunication	50
	Total	3825

Source: Subcontracting cell, BSCIC, Dhaka, April 2004.

The above data clearly shows the subcontracting programme in Bangladesh has encouraged the local light engineering industries to produce the items those once believed impossible to be produced locally.

The exact number of SMEs in Bangladesh is not available from any source. But by an estimation of Bangladesh Small and cottage Industries Corporation (BSCIC) the number of small industries is about 56000 and the number of cottage industries is around 512000, which excluded handloom, software and apparels. Taking these numbers into account the number of small and cottage industries will be well over 60,000 and 600,000 respectively. The number of medium scale industries in the country is around 20,000 (collected from an account of SEDF). Therefore, taking all these numbers together, the total number of SMEs in Bangladesh is 680,000. This estimate shows the number of SMEs in the manufacturing sector

only. A large number of SMEs have been excluded from this estimate, which among others include the informal and service sectors.

SMEs play a very important role in the economy of the country. They employ more than 80% of industrial employment and they comprise 90% of all industrial units in the country. This is of course a common phenomenon in most of the developing counties of the Asia Pacific region (Ahmed M.U.1999). Though the exact estimation of contribution of value addition is not available from any source, the share of SME's value addition has been found to be around 40%--50% of the total manufacturing value.[26] The SMEs in Bangladesh cover a wide variety of fields but the main areas of their interest may be classified as food, light engineering, wood, textile, chemicals, electrical accessories, cane and bamboo, glass and ceramics, tannery and leather, cable and wire, hardware, etc. Electronics and very recently software are also growing up as new areas of interest.

According to industrial policy 1999 an industry is said to be large when it employs more than 100 workers and/or has capital assets in access of 30 crore taka. Medium scale industry is an industry, which employs 50-99 workers and/or has fixed assets in access of taka 10 crores but less than taka 30 crores. Small industry is defined as an industry, which employs less than 50 workers and/or has capital assets less than 10 crore taka. A cottage industry is one, which is run by mostly the family members and invests not more than taka 500000. So, from the above classifications it may be said that, a SME is an enterprise, which has a maximum of 99 workers and/or has maximum fixed asset of taka 30 crores. But the limitation of number of workers will be ignored for the purpose of this paper, as it is not practically possible to ascertain this number for most of the industries.

It may be mentioned here that the number of workers was never a part of this classification in any of the industrial policies in the past. It is not at all necessary to use these two criteria simultaneously. More over it is not practically possible to ascertain particularly when this number falls on the margin of any adjacent class of industry (say from 49 to 50 for becoming SSI to medium-scale industry)[27]. This imposition of limit on the number of workers is bound to discourage SMEs or particularly SSIs to employ more than 49 workers for fear of becoming medium-scale industry and thereby losing fiscal and other incentives often given to SSIs. Others will even hide their actual number of workers. Actually number of workers and investment limits need not be used simultaneously as criteria for such classification. "If we want to use both criteria simultaneously it will not be possible to classify them at all."[28]

In Bangladesh SMEs had begun to grow slowly without any conscious support from any authority before partition of the Subcontinent in 1947. During Pakistani reign, after the establishment of Bangladesh Small and Cottage Industries Corporation (BSCIC) in 1957, the process took up a better pace than before. Than after the liberation of Bangladesh in 1971, the chances of even faster growth appeared and till now the process has been continuing. The average annual growth rate of SSI sector (excluding handlooms) in Bangladesh has been exhibiting dynamism (Table-3).

Table-3

Year	No. of Units		Employment		Value Added (Tk.)
	Small	Cottage	Small	Cottage	Small and Cottage Combined
1981	24590	321743	322110	855200	17987
1991	38294	405476	523472	1331032	21154
2001 (end of June)	55916	511621	808959	166724	29323
Average Annual Growth Rate	6.4%	3.0%	7.6%	4.7%	3.2%

Source: Ahmed, M.U., 2001

Table-3 shows annual growth rate of employment and number of units at 7.6% and 6.4% respectively in SSI sector. While these two are showing a reasonable growth, the average rate of annual value addition of only 3.2% shows a depressing performance. But some researchers confirmed that this has been occurred due to weak estimation of Bangladesh Bureau of Statistics (BBS) [29]. This estimates are later on revised using a new system (New System of National Accounts or SNA 1993) by BBS and found that the SME's contribution towards value addition stood at 7.7% per annum during 1989-90 and 1994-95.[30] Table-4 below shows major sub-sectors of SSIs in Bangladesh and their numerical strength.

Table-4

Industry Sub-sectors	No. of Units, 1978		No. of Units 1991	
	Number	% of Total	Number	% of Total
Rice Mills	12242	51.00	13482	35.21
Bakery	2167	9.02	2765	7.22
Flour Mills	1315	5.42	1718	4.45
Light Engineering Works	1120	4.66	2252	5.88
Printing & Publishing	995	4.14	1775	4.64
Readymade Garments	757	3.15	2365	6.18
Saw Mills	713	2.97	1023	2.67
Soaps	143	0.59	351	0.92
Plastic Products	74	0.31	725	1.89
Automobile Servicing & Repairing	296	1.23	550	1.44
Total	19822	82.6 %	27006	70.5 %

Source: Ahmed, M.U., 2001

In Table 5 below the growth rate of all manufacturing industries at constant price of 1995-96 has been shown. It is found that during 1999-2003 the growth rate has not been very encouraging. The slow growth was caused due to prolonged flood of 1998, but it is also visible from the Table 5 that SSI growth rate was on acceleration during the year 2000-2003, after the flood. Though the Table shows only 10 major areas of SMEs, Survey report, 1994 of BSCIC showed there are 197 types of SCIs in the country covering a wide variety of manufactures.

Table-5

Year-wise growth rate of large, medium and small industries:

Year	Large & Medium Industries (%)	Small Industries (%)	Total Mgf. Industries (%)
1998-99	4.19	0.75	3.19
1999-00	4.35	5.80	4.76
2000-01	6.55	7.02	6.68
2001-02	4.60	7.69	5.48
2002-03 (Provisional)	6.04	8.01	6.62

Source: Bangladesh Arthonitik Samiksha, 2003, Ministry of Finance, GOB.

It has been observed that small industries or SMEs have greater dynamism and has higher growth potential in the national economy thus deserves greater attention to make them competitive and face increasingly fierce global competition.

11. TECHNOLOGY POLICIES RELATED TO INDUSTRIAL/ SME DEVELOPMENT IN BANGLADESH

The government of Bangladesh has given priority to science and technology in overall national development programmes. This has been reflected in all of its related documents these are as follows:

11.1 National Science and Technology Policy 1986, The main features are[31]:

- To attain scientific and technological competence and self-reliance, to help increase production and development in various sectors and sub-sectors of the economy.
- To be in consonance with the socio-economic, cultural, educational, agricultural and industrial policies of the nation.
- To contribute to the worldwide pool of science and technological knowledge.
- To seek out and recognize high talents in various areas of science and technology.
- To strengthen co-operation in science and technology between developed and developing countries, and particularly among developing countries themselves.
- To provide guideline for institutional arrangements or rearrangements in the R&D structure (including education and training) for attainment of the above objectives.

To co-ordinate science and activities, National Council for Science and Technology (NCST) was also setup with following objectives:

- Recommend national policies on science and technology.
- Recommend priorities to specific research programmes, evaluate the quality and effectiveness of research programmes undertaken by various agencies and assess the extent to which results are put to actual use.
- Suggest measures for coordination of scientific research and development activities;
- Recommend approval to research plans and programmes;
- Such other activities, the Government may consider relevant.

For effective implementation of the science and technology policy the NCST has formed a consultative committee on Technology Transfer with the following aims in view:

- To ascertain country's technology demand and capabilities;
- To provide recommendation in preparation of technology plan;
- To render advise on the type of technologies to be imported in the country.
- To provide direction for the diffusion of imported technologies and to recommend policy measures necessary for the same;
- To advise on any other matter deemed necessary for the government on technology transfer.

In Bangladesh there are now around 60 R&D organizations (Annexure 3) and supporting technical facilities under various Ministries, Universities, Research council, Board, Industrial corporations, Non-governmental organizations and International agencies. Inspite of the government recognition of the importance of STR, efforts to achieve them in physical terms are very inadequate. In-house research set-ups are conspicuously absent in industries. The R&D institutions are particularly deficient in design and engineering aspects and testing of models for pilot processes. There is lack of coordination in research largely due to institutional and functional weaknesses[32].

11.2 Industrial Policy (I.P) 1999

The Industrial Policy (I.P) 1999 envisages a sizeable industrial sector within a decade to generate 25% of the GDP and create 20% of the employment and a vibrant and dynamic private sector as the principle actor in the industrial arena. It also focused on dispersal of SMEs and industrialization in accordance with the dynamic comparative advantages of the economy. I.P'1999 as one of its vision mentioned " given Bangladesh's resource endowment the principle of dynamic comparative means production of labour intensive manufactures with skill upgradation and productivity growth as its cutting edge. This however, does not preclude the possibility of Bangladesh having a niche high-tech industrial sub-sector that may be extremely competitive."

I.P 1999 has the following pertinent (with SME/technology) objectives:

- To focus the role of government as a facilitator in creating and enabling environment for expanding private investment;

- To raise industrial productivity and to move progressively to higher value added products through skill and technology up gradation;
- To ensure rapid growth of industrial employment by encouraging investment in labour intensive small and cottage industries;
- To attract foreign direct investment in both export and domestic market-oriented industries to make up for the deficient domestic investment resource and to acquire evolving technology and gain success to export market;
- To diversify and rapidly increase export of manufactures;
- To encourage the competitive strength of import substitution industries for catering to a growing domestic market;
- To ensure a process of industrialization, which is environment friendly and consistent with the resource endowment of the economy;
- To encourage balanced industrial development throughout the country by introducing suitable measures and incentives;
- To effectively utilize the existing production capacity;
- To rehabilitate deserving sick industries; and
- To develop indigenous technology and to expand production based on domestic raw materials.

A brief account (from 'industrial technology' chapter of I.P 1999) of the aims of I.P 1999:

- To facilitate change and advancement of technology to gain and retain competitive strength;
- To reduce consumer cost through use of cost effective technologies;
- To promote improved management and production by providing flexibility to operate efficiently within a changing global and local market condition;
- To review periodically the relevant public policies to achieve these aims.
- To support new technologies in desired targeted areas;
- To simplify procedure for licensing of imported, adapted and domestic technologies;
- To corporate culture conducive to HRD and creation of a workforce capable of adapting to technological changes;
- To provide tax break to approved R&D expenditure; and

- To establish links between universities, research institutions and industries for dissemination of research results.

The I.P 1999 has entrusted BSCIC with the following to promote the small and cottage industries:

- Arrange special credit line;
- Allocate industrial plots in the BSCIC estate;
- Organize entrepreneurial development programme;
- Oversee extension of infrastructure facilities to SCIs;
- Support market development programmes for SCIs products;
- Register the units and monitor the performance of the sub-sector.

In addition, BSCIC performs the following as a part of its own objectives:

- Undertakes product development and disseminate the knowledge;
- Establishes industrial estates all over the country for SCIs;
- Enlists the subcontracting units and establish linkage with buyers for them;
- Provides support services for entrepreneurial consciousness on environment and pollution control;
- Publishes technology bulletin;
- Provide industrial counseling to the entrepreneur.

Functions of Board of Investment (BOI) related to SME development:

- Undertaking investment promotion activities at home and abroad;
- Extending "One Stop Service" to the investors;
- Providing all types of facilities for promotion of capital investment;
- Approving payment of royalty, technical know-how and technical assistance fee to foreign nationals.

Facilities to SCIs/ SMEs:

- SCIs get special fiscal incentives;
- Sub contracting industries/units get facilities similar to those of SCIs irrespective of their location;
- Tax holiday is allowed for five years in Dhaka and Chittagong divisions and for seven years for industries in other places;
- Industrial units not enjoying tax holiday enjoy accelerated depreciation allowance;
- Value added tax (VAT) is not payable on import of capital machinery and spares;
- Private sector industries located outside EPZ and Joint Venture and locally owned industries in the EPZs may with prior approval of Board of Investment (BOI), enter into supplier's credit and foreign currency loan contracts with lenders abroad;
- 100% foreign owned industry located in the EPZ may freely borrow abroad without any prior approval.
- Remittance abroad toward repayment of principal and interest on these borrowings may be sent through banks without prior approval of Bangladesh Bank;
- Cascading duty structure for imported raw materials, intermediate inputs and finished products in ascending order;

- For industries established on entrepreneur's own land, they are not required to pay transfer fees and/or capital gain tax for new enterprise or during converting existing enterprise to ' Limited Company' without changing the ownership structure.

These incentives greatly reduce the cost of establishing new enterprises and also reduce cost of production of their manufactures, which help them make competitive.

11.3 Fifth Five Year Plan (1997-2002):
(From Chapter xiv of planning document)

Objectives and Strategies for Industrialization (Only pertinent points in brief):

- To encourage domestic and foreign investment for overall industrial development;
- To promote diversification of market as well as products;
- To develop skill and extend vocational training;
- To encourage development of labour intensive small and cottage industries through acquisition and development of appropriate technology;
- To develop data base at the frontiers of international technology shelf and disseminate the same to the users; in particular, modern technologies will be required in areas such as electronics, biotechnology, cybernetics (both hard and soft ware); R&D facilities will be developed in these and other modern technologies. To facilitate this, research in basic science will be encouraged;
- To encourage development of industries based on indigenous raw materials and technologies;
- To put special emphasis on the growth of productivity in industries:
- To strengthen quality control practices so as to ensure country's manufactures confirm international quality standards.

The document also mentioned " This will be achieved through building of indigenous capacity in science and technology as well as enhanced access to the frontier of international technology shelf by way of adoption and adaptation. Such access to modern technology will be an end of, as well as means to industrial development."

11.4 Export Policy 2003-2006 envisaged establishing a product development institute in the country. It has also pledged for product development, production of high value items and improvement of design using modern technology (Para 3.3, 4.6 and 10.5).

12. CONSTRAINTS OF SME DEVELOPMENT IN BANGLADESH

SMEs all over the world face many constraints and Bangladesh cannot be an exception in this regard. SMEs in Bangladesh face a number constraints to grow, these are:

- Lack of modern/appropriate technology;[33]
- Lack of access to technological information and consultancy service;
- Isolation from technology hubs;
- Emphasis merely on production and less/not conscious about production cost, productivity and impending competition;
- Lack of adequate investment and desire to avoid risk;
- Poor information about market opportunities;
- Lack of marketing facilities and market access;
- Lack of skilled manpower;

- Lack of R&D facilities;
- Inadequate institutional support services;
- Irregular and inadequate supply of power; and
- High rate of interest on bank loan and lack of efforts from bankers to fulfill their promotional role.

These constraints have been identified as the most common problems encountered by SMEs in the country. But these are also true for SMEs in light engineering, agro-processing, electronics and software. For the convenience of discussion the above constraints may be classified in three groups i.e. Technological, Managerial and Marketing. Among the above constraints 1-3 belong to Technological, 4 and 5 belong to Managerial and 6 and 7 belong to Marketing but 8-12 need direct government intervention and assistance for their mitigation. But even the constraints indicated in 1-7 cannot be solved by SMEs alone. The above constraints are analyzed bellow with their probable solutions with respect to the present global perspective and on the basis of existing status of SMEs in the country. Actually, for mitigating these constraints both governmental and in many cases international assistances will be necessary, as are in practice elsewhere in the world.

12.1 Technical Constraints: Lack of Modern/Appropriate Technology

Indeed, experience has shown that the efforts of entrepreneurs are often frustrated by the lack of knowledge of the availability of small and affordable modern machinery to serve in most of their specific situations and particular needs. For example, in the light engineering sector, there is hardly any firm using modern machines like EDMs, Laser Cutting Machine, CNC Machine, Opto-electronic apparatuses, etc. for production and testing of spare parts, sheet metal works, die making, etc. The foundry shops are also characterized by traditional furnaces without any modern testing facilities like Carbon and Sulphur analyzer, Atomic absorption Spectrometer, etc to check properly the exact material composition of metal and alloy. There are many even among those who know about the sources of affordable modern machinery, are reluctant to procure them for fear of shortage of expertise to operate and maintain them.

12.2 Isolation from Technology Hubs and access to Technology Information

SMEs in Bangladesh have been enjoining industrial estate facilities since early 1960s. The government has entrusted BSCIC to establish these industrial estates and till now it has established at least one estate in almost every district of the country and many are underway. It has also established mono estates like, Electronics Complex and hosiery estate; a project for establishing a leather estate is underway. But Bangladesh is yet to establish much-needed IT Village/IT Parks for the development of software business in the country. "The approach encompassed by the concept of such Village/Parks/Clusters, offer new insights into the potential role of SMEs in exchanging their access to new technology. Sector-specific and geographically bounded clusters seem to be a common phenomenon for small scale manufacturing in developing countries"[34]

Access to advanced technologies and assistance in upgradation and adoption is crucial to build up Indigenous Technological Capacity (ITC) to face international competition. In the present scenario of globalization, knowledge of and access to latest advances holds the key to international competition. In this venture the industrial sectors, which are able to identify their technology needs and adapt in time, will benefit the most.[35] Almost all SME sectors need to be technologically upgraded to be competitive in the present global perspective. In this direction, the government of India has taken a number of efforts like, Asian and Pacific

Centre for Transfer of Technology (APCTT), the National Small Industries Corporation (NSIC) and the Council of Scientific and Industrial Research CSIR, India, have formed a consortium to assist small-scale industries there. Bangladesh also needs to develop such institutional support services for SMEs. Bangladesh National Scientific and Technical Documentation Centre (BENSDOC) is the national focal point for scientific and technical information. BENSDOC may help industries in the field of bibliographic, procurement, translation and photographic services and it may provide 'as per requirement' services for information including computer and data bank service. But formation of consortium to assist SMEs in technological innovation and up gradation, like those in India is being felt very essential.

12.3 Industrial Consultancy

Consultancy plays a very important role in industrial development. Their role in industrial development particularly in technology innovation and technology need assessment, R&D and specialized knowledge has become more crucial now even for SMEs for their survival/enhancement of competitiveness. Consultants can help to compensate for the meager technical, managerial and financial resources of SMEs.[36] A consultant is expected to be equipped with technical and managerial knowledge and expertise; marketing information including requirement of industry and project authorities and sources of technology and technical services. SMEs in Bangladesh cannot afford to engage consultant for their purposes and no government agency has the provision to do so except BSCIC. But BSCIC lacks real expertise in consultancy. It has no definite programmes to upgrade the standard of consultancy or even counseling for the entrepreneurs.

12.4 Managerial Constraints: Emphasis merely on production and less/not conscious about production cost, productivity and impending competition; and Lack of adequate investment and desire to avoid risk.

The majority of the world population particularly those who live in less develop countries still depend on the traditional knowledge of flora and fauna for food and medicine. They also depend on traditional technologies for meeting other daily needs. This knowledge has to be supplemented by modern technology. Government as well as international development agencies have not built upon their knowledge nor helped upgrade the traditional by blending with the advanced. Despite technological revolution underway in developed world, in most less developed countries per capita national product and share in the world trade have not been improved. This impoverishment is being caused by failure of macro-economic policies and political democratization, exacerbated by inadequate acquisition and application of technology, R&D expenditure etc. Nevertheless, a dozen newly industrialized countries (NIEs) now have the technical infrastructure for innovation and up gradation of technologies, but for others, appropriate technologies adapted, applied and absorbed can improve their lives.

The impetus of change must come from the all sections of society, under competent political leadership and management. If SMEs are to survive in the present global competition quickening the pace of technological innovation and upgradation is essential to support them. Innovation in/for industries means the dynamic, integrated chain of activities, starting with the identification of a new concept to meet a market opportunity followed by its pursuit to commercialization. It may originate on a factory floor not just for a major break through but may even for any incremental change to improve productivity/competitiveness. But it requires investment in technology from own stock or from other sources. Investment also may require in the import of know-how.

The traditional technology and traditional products were never challenged in a protected market and SMEs never had to think about any major change in their norms of production/process and traditional and stagnant market never could make them think about any improvement on technology and product based on market demand. Actually, SMEs cannot afford to change/upgrade technologies due to financial and other constraints. The availability of financial resources on affordable term and in a non-bureaucratic manner is yet another problem, which SMEs have to confront, hindering access to new technologies. They suffer from problems of sub-optimal scale of operations and technological obsolescence. They have no financial and technological capability to identify technological sources and evaluate alternative technologies that would suit their requirements; this managerial capacity is conspicuously absent in most SMEs.[37] So, they rely just on production and compelled to ignore any effort for upgradation and product development even in this fierce competition. But this will eventually take them out of market.

Technology lifecycle and product lives are becoming shorter and sorter because of faster technological developments and stricter requirements from customers as well as more competing market force nationally and globally. Production facilities are being internationalized, technologies are being globalized, markets are being unified and more and more corporates are becoming outward looking in various countries, making the competitiveness of SMEs more difficult. Any effective technological capacity building exercise by both at national or enterprise level management to enhance competitiveness of SMEs will have to address the issues like knowledge acquisition and dissemination, new technology assimilation and financing and institutional support systems. In each of the above issues, the barriers must be clearly identified by the management so that the technological capacity building process in SMEs become meaningful, in terms not only of international trade and business or of environment, but also of making it responsive to the need of the people. Avoiding entrepreneurial risk will risk exclusion from new trading opportunities.

SMEs in Bangladesh especially the older and the long established ones, face serious survival problems in the emerging era of knowledge. Many of them are finding it culturally and managerially difficult to establish beachhead with business relevant to R&D/modern machinery and manufacturing processes and thus transform themselves into competitive enterprises in the emerging environment. Those, which will be unable to undertake the transformation, will unlikely to survive. Unfortunately, as yet, there are no visible signs to suggest that traditional SME business leaders and managers are able to comprehend the role of knowledge and importance of R&D/innovation/ use of appropriate modern machines in business, for farther prosperity and growth of their companies, in a manner, which their counterparts including large industries are doing in other parts of the world. Extensive, effective and continuous training should be provided to the entrepreneurs and managers of SMEs to make them aware of the changed perspective and equip them to be able to take the challenges.

12.5 Marketing Constraints: Poor information about market opportunities; and Lack of marketing facilities and market access

SMEs in Bangladesh are facing difficulties arising from the adjustment they have to undertake in the face of the liberalization and globalization of markets. Current developments in the global market are resulting in substantive changes in the form and context within which business will operate. The trend towards market orientation, liberalization and globalization is forcing SMEs to look ahead and rethink their strategies. In particular, the recent progress in information technology, telecommunication and transportation has accelerated the

globalization process. As a result the distinction between domestic and foreign markets is loosing its relevance. This is offering opportunities as well as challenges to all business concerns, especially SMEs. Opportunities, because they can sell more, invest more freely across boarders. Now the young aggressive, nimble, technology-based entrepreneurial companies are becoming the new "engine of economic growth"[38].

Multiple players are competing to provide the best goods and services and technologies to customers as a result of market driven and competitive environment in this present globalization process. The globalization has made SMEs to operate in a very competitive world. Usually they are to enter into the niche market that large enterprises currently cannot serve. To survive in this keenly competitive market SMEs must learn to monitor market developments. They should also develop business intelligence as a tool for assessing necessary areas of trade. In fact, due to their limited resource it is difficult for SMEs to directly invest in such endeavours. In addition, SMEs in Bangladesh have no knowledge to develop and use these techniques of their own. They need support in many ways. Most SMEs in Bangladesh have difficulties in undertaking market research and developing name-brand products. In that case they can become part of the value chain as sub-contractors. UNIDO's Sub-contracting and Marketing Exchange help link roaster of suppliers with the main contractors and provide related supports[39].

SMEs in Bangladesh do not have enough resources for advertisement of their products in any media and develop a steady marketing network. The majority of them are not conversant with e-commerce as yet. Even export-oriented SMEs have adopted very little marketing techniques except linkage with multinational buyers or sub-contract with potential buyers. Now, SMEs in Bangladesh are operating in a fierce competition with foreign goods and services. They therefore, must select appropriate niche and adopt all marketing techniques for their survival and for which they definitely need help and appropriate policy supports from all related agencies and the government.

12.6 Lack of R&D Facilities

There is no in-house research facility in any of the SMEs in Bangladesh, mainly due to resource constraints and cultural indifference. They mostly grew up as traditional enterprises. They therefore, need R&D supports from the country's relevant R&D organizations, like many other countries of the world. Bangladesh has around 60 R&D organizations (Annexure 3) in various disciplines. But all universities and R&D organizations in the country are in extreme distress in the absence of modernization and paucity of funds. Indeed majority of them are in a state of terminal decay and are not in a position to support SMEs in the country. They should be given policy and financial supports to modernize their laboratories to start a new dimension of learning through cooperation with industries, like in other developing countries where already a knowledge revolution is taking place through such cooperation and many of these efforts are turning into harbinger for success in business. Selecting a few suitable R&D organizations, their R&D facilities should be strengthened, at least in relevant/prioritized areas of industrial interest. They may be even grouped (in 2 or 3 organizations) together to form consortiums under NCST's guidelines to make provisions for incubators/R&D services (need based) for the industries/SMEs of the country. If necessary other relevant organizations with potentials may also be included in such groups (examples: from India shown in page 31 Para 3 and from Taiwan shown in page 16 Para 5). Group should be formed only when one single organization will not be found enough to support the necessary R&D activities alone. In Bangladesh the following groups may be formed sector-wise:

Light Engineering:

a. Bangladesh University of Engineering and Technology (BUET)
b. Bangladesh Machine Tools Factory (BMTF)
c. Bangladesh Industrial Technical Assistance Centre (BITAC).

Agro-processing:

a. BUET
b. Farm Machinery and Post harvest Technology Division, BRRI, Gazipur.
c. Food Division, Bangladesh Council of Scientific and Industrial Research (BCSIR).

Electronics:

a. Applied Physics and Electronics Department, University of Dhaka,
b. Electrical and Electronics Department, BUET,
c. Institute of Electronics, Atomic Energy Commission.

Software:

a. Computer Science Department, Dhaka University;
b. Computer Engineering and Science Department, BUET;
c. Bangladesh Computer Council (BCC).

Similarly, R&D, incubator facilities or technical assistance programme may be conducted for other sectors by forming such group with other relevant R&D organizations, educational institutes and assistance centres. But before taking up such programmes, modernization of these organizations should be done by the government. NCST may play a role in this direction by providing policy supports and through arranging inter-ministerial coordination. Efforts must also be taken to motivate the organization in this line with proper financial supports and attract the industries to take advantage of this support services.

12.7 Inadequate Institutional Support Services

Small and cottage industries in the country has been enjoying support services from BSCIC since its inception in 1957. But medium-scale industries has none to support or assist except getting a registration from Board of Investment (BOI). But there is no separate organization to support SMEs in Bangladesh. In the changed business perspective, SMEs even in the most developed countries are given all possible supports by their governments. For example, with its country wide network SBA in the USA provides all supports to SMEs (for details, http://www.sba.gov/aboutsba/principle.html). India has a strong network of assistance centres (Annexure 9) all over the country to assist SSIs. The assistance package contains finance, management, business opportunities, technology, training, etc. Bangladesh therefore, should take adequate steps to support SMEs through strengthening the existing organization like BSCIC and other R&D and educational organizations. Actually, SMEs in Bangladesh need technological upgradation and modernization the most to make them competitive. Therefore, an organization like SMIDC (Annexure 4) in S. Korea may be established to promote SMEs in the country.

12.8 High Rate of Interest and Lack of Promotional Role of Banks

At present, interest rate on bank loan varies from 10% to 18%. Recently, the government has reduced the interest rate considerably but amazingly no bank has implemented the order so far. Even after repeated orders from the government and Bangladesh Bank, the schedule banks are showing their reluctance to comply them. SMEs are severely in need of finance for their modernization, upgradation and adjustment of scale of production and quality to suit the

requirements to make them competitive in the changed global perspective. SMEs, for their inherent resource constraints, cannot finance these improvement needs of their own. The scenario is almost same even in the most developed countries of the world. In the USA, the government has thus providing loans very liberally to them. For example, SBA in the USA has programmes to finance even those small business enterprises that are not eligible for loans through normal lending channels. The SBA function states:

"Serve as the SBA's primary business loan program to help qualified small businesses obtain financing when they might not be eligible for business loans through normal lending channels. It is also the agency's most flexible business loan program, since financing under this program can be guaranteed for a variety of general business.

Loan proceeds can be used for most sound business purposes including working capital, machinery and equipment, furniture and fixture, land and building (including purchase, renovation and new construction), leasehold improvements, and debt refinancing (under special conditions). Loan maturity is up to 10 years for working capital and generally up to 25 year for fixed assets".

In Bangladesh, such long-term loans, though very practical, is not available from any source. Moreover, curse of bureaucracy and corruption is on rampant in all public banks. Private banks are not at all interested in providing long-term industrial loans. The bankers treat SMEs in a way, as if they are not genuine borrowers. The bankers show less interest towards SMEs because almost all of them expect illegal commission on percentage basis (on loan amount) and big loan amount can bring big commission. Generally, the bankers are interested to grant short-term commercial loan (not without commission) and long-term loans for getting illegal commission.

Actually SMEs need long term and affordable loans i.e. at low interest rate. In IP'1986 there was a provision for separate windows in the banks for small industries. This facility has been withdrawn later on. But in the present global business context, when it has become necessary to modernize and revitalize SMEs to make them competitive, such separate window with loan facilities on easy terms has again become more crucial for encouraging the entrepreneurs. All DFIs may follow SBA's model for loan terms i.e. 10 years maturity time for working capital loans and 25 years for fixed capital loans. This will help SMEs the most because longer period of loan repayment time will allow them to pay smaller installments.

12.9 Irregular and Inadequate Supply of Power

At present the total generation capacity of the country is 371100 MW but the actual generation is only 3200MW against the total requirement of 3800MW. The problem needs due attention from the government. This shortage is posing a serious threat on the overall economy of the country. The problem has been manifested itself into industrial disaster. The industries, large or small fail to achieve their targets of production, maintain schedule and working hours etc. causing irrecoverable losses. For example, if power supply ceases in a foundry after charging few tons of steel for hours in its induction furnace, it is easy to imagine the losses the foundry will incur. It will also have an adverse effect on the cost and schedule of production. Installing new generators is not easy. It is time consuming as well. The government therefore, (as, till replenishment of this shortage, load shedding will continue) should keep industrial clusters and growth centres out of load shedding schedules.

12.10 Lack of Skilled Manpower

In the present scenario SMEs need to be technologically upgraded to face the challenges of globalization. Knowledge and access to latest advances in technology hold the key to international competition for SMEs. Access to advanced appropriate technologies and adaptation of these technologies is crucial to build up indigenous technological capacity, which SMEs now need the most. In the age of rapid technological development, higher quality requirements, competitive national and international environment and the increasingly multidisciplinary nature of developmental activities, it is unlikely that an organization would have adequate expertise and capabilities relevant to these needs. This is even truer in the case of SMEs where technical, managerial and financial resources are very limited.

It would be worth mentioning here that there are two main challenges that can make and break SME in the near future. First, there is need for internal reorganization and professional education of management in order to cope successfully with further internationalization. In wider and more integrated economic environment, the diffusion of information and technology will be even faster than today. Therefore, flexibility and adaptability increasingly requires a highly trained management and labour forces. Even traditional family based firms need to be supported by specialized manager-entrepreneurs. Second, the globalization process accelerates and fosters competition imposing new forms of cooperation among firms. Geographical proximity becomes less important. Under the pressure of competitiveness and cost minimization firms are forced to search for their suppliers, not just next door. On the other hand, the increasing sophistication of products requires closer cooperation among firms. If SMEs adapt to such significant changes in terms of improving the degree of internationalization and achieving higher shares of the external markets, they will continue to lay a major role. SMEs, therefore, need very knowledgeable and skilled management. They also need all possible supports from the public sectors in strengthening the instruments of internationalization, promotion and in using more resources for R&D and training programmes.

The lack of workers with technical skills is the most significant barriers to the growth of SMEs in industry and services. This problem should be addressed by encouraging SMEs to invest in the training of workers and developing their basic skill and by ensuring that the credentials and skills of these workers are recognized in the enterprise. In this regard regional efforts like proposed (proposed by Philippine during the APEC during the APEC Economic Leaders Meeting in Blake Island, Seattle, in1993) APEC Centre for Technology Exchange and Training for SMEs (ACTETSME) may also be pursued. At the national level training centres like, 3 centres of BITAC and 13 Skill Development Centres of BSCIC should be modernized and upgraded with sophisticated machinery and equipment to provide need-based training on technical subjects by introducing updated curriculum. At least one of these Centres should be upgraded as Hi-tech vocational training centres like those in India (Annexure 5). Bangladesh Management Development Centre (BMDC) and Small and Cottage Industries Training Institute (SCITI) of BSCIC should also increase and diversify their training programmes to cope up with increasing needs of training in the field of management and marketing for SMEs with new curricula to suit the requirements of the present globalization trends. In all such programmes the trainers should be trained first to update their knowledge in the context of present global scenario of technology, management and marketing.

DISCUSION ON FOUR SME SUB-SECTORS

With all these constraints, SMEs in Bangladesh are contributing a lot to its economy in terms of GDP and employment generation. SMEs cover a large number of sub-sectors but detailed discussion of all the sub-sectors is beyond the scope of this document. Only four sub-sectors i.e., Light Engineering, Agro-processing, Electronics and Software are discussed bellow. The

discussion will cover their present technology status and technology needs for attaining competitiveness, and prospective areas of business in the present global perspective and constraints.

LIGHT ENGINEERING

General Discussion:

SMEs in Bangladesh predominantly depend on conventional and indigenous technologies. For example, SMEs in light engineering use the conventional and indigenous machines like, lathe, shaper, milling, etc. They are yet to introduce CNCs for machining operations. Most of the entrepreneurs of SMEs do not even know about these new machines. Use of Atomic Absorption Spectrometer for material testing is still to be found, even not many foundries have/use conventional (cheap but inaccurate and presently almost obsolete) chemical analytical laboratories for material testing. Most of them have to rely only on suppliers for material specifications. There are even others who never care to know the specification of the material (most of which they collect from the junk) they use for manufacturing spare parts. SMEs therefore, lack precision, speed and quality.[40]

A list of modern machines, which are most appropriate for SMEs for their becoming competitive in the present global market, has been shown in (Annexure 6). If engineering industries in SME sector can introduce these modern machines (Annexure 6) in their production line, the quality of their produced machines and spare parts will improve. But introduction of this machinery will require enough investment and trained manpower to operate them. But these machines are very essential and appropriate for any mechanical or light engineering enterprise to manufacture precise and acceptable quality products/spare parts as the competition with foreign products is intensifying even in the local market with the introduction of liberal import policy. These two types of machines i.e. conventional machines and CNCs can be easily compared by their tolerance; CNCs machines have tolerance of the order of 0.000005 of an inch against 0.05 inch of conventional machines.

One of the major characteristics of the LEIs is that, they serve the local needs and can function in any economic sphere of the country. Now there are strong backward and forward linkages between LEIs and other sectors of economy by supplying wide range of products (Annexure 7). Apart from its economic potentials, LEIs/SMEs are the 'seed bed' of indigenous entrepreneurship. LEIs provide productive outlets for individual with independent and enterprising mind (Kohlo, 1991: 34). LEIs occupy a unique position in the economy; it contributes towards the livelihood of the millions. Viewing the employment potential, less investment requirement and its suitability for uniform regional development, due emphasis must be given to this sector. Most of the LEIs in the country are operating outside the industrial estates of BSCIC but majority of them grew up in areas where they found it prospective. So, there are some growth areas for LEIs spontaneously spread all over the country like Dholaikhal in Dhaka.

It is worth mentioning here that, most of the developing countries around the world, have been providing institutional support services to their SMEs for quite a long time through setting up of different types of technical training centres to help their technical work force up date their knowledge of using new and appropriate machines. For example, a CAD/CAM Centre in Bangalore, India has been set up by the government of India in association with Auto Components Manufactures Association (ACMA) to give SMEs the necessary technical support (more examples are in Annexure 8 and Chapter 9.1). But Bangladesh is yet to establish such centres, only BITAC has been extending some supports (though inadequate) only in the area of Mechanical Engineering and Metallurgy, since its creation in 1962. Now

BITAC also needs up-gradation. Recently a proposal has been made to Ministry of Commerce, to establish a 'Common Facility Centre' (which was prepared by a committee formed by the government with the author as its convener), for Light Engineering Industries (LEIs) with a view to extending necessary services to the sector including training on operation of modern and sophisticated machinery, product development, modern die making, modern foundry shop practices and testing of material and engineering products. Common Facility Centre (CFC) will have the following facilities:

- Testing and measuring laboratory;
- Metallurgy testing laboratory;
- Electrical testing laboratory;
- Electronics testing laboratory;
- Product development workshop;
- Die and mold making workshop;
- Modern workshop facilities;
- Heat treatment facilities;
- Modern foundry shop; and
- Hard crome plating facilities.

The CFC will provide necessary support services to SMEs to encourage them to modernize and upgrade their existing level of technology and know-how on modern and sophisticated machinery and equipment. It will also help them to upgrade their products using its product development facilities, which SMEs cannot create through their own efforts. Ministry of Commerce also has constituted 'Light Engineering Product Business Promotion Council' with secretary, Ministry of Commerce, as its chairman; to help this sector in a way so as to make the LEIs become capable of exporting targeted spare parts and other engineering products. It is hoped that the CFC will be able to play a great role in this direction.

Since the beginning of the industrialization process in Bangladesh the market opportunity for LEI has been the most easily to avail. In every part of the country LEIs are found the most. From very small workshop with merely a welding set to moderately equipped workshop with machinery like, lathe, shaper, milling, planner, jig boring, etc. are found in every districts of the country in large numbers. They are engaged in local repair and maintenance works and in producing replaceable items like, gears, shafts, crankshafts, pistons, etc to more complicated spare parts of automobiles, railway locomotives, marine transports, textile and jute mill, sugar mill, gas line fitting, etc. A few of them also make complete machinery for agro-processing, pharmaceuticals, workshop, jute and textile, garments, construction, water transports, etc. (Annexure 7). But LEIs in Bangladesh are dependent on conventional machines. They are yet to introduce computerized machines (CNCs) for precision jobs and without which export of spare parts from Bangladesh may remain almost impossible. Besides, the country is yet to create much-needed modern die making and modern foundry shop facilities. So, there still exist profitable scopes for SMEs if they are prepared to employ modern equipment and machinery, these are:

- Modern workshop with CNCs (list of machinery in Annexure 6).
- Modern die making shop with EDMs and CNCs (list of machinery in Annexure 6).
- Modern foundry shop with Atomic absorption spectrometer for alloy and composite material casting (list of machinery in Annexure 6).
- Precision sheet metal pressing workshop with hydraulic press and other precision machines.

Products of these LEIs, if established, will enjoy opportunities both in the local market, in the absence of any local competition and in the export market taking advantage of the cheap labour and abundant gas resources to support the energy requirements particularly for the foundry shops.

Summery of Discussion:
In every part of the country LEIs are found, since market opportunity for LEI has been the most easily to avail. They are engaged in local repair and maintenance works and in producing replaceable items like, gears, shafts, pistons, etc to more complicated spare parts of automobiles, railway locomotives, marine transports, textile and jute mill, sugar mill, gas line fitting, etc. A few of them also make complete machinery for agro-processing and food, pharmaceuticals, workshop, jute and textile, garments, construction, water transports, etc. (Annexure 7). But LEIs have the following limitations:

- LEIs in Bangladesh predominantly depend on conventional and indigenous machines like lathe, shaper, milling, planner, etc.
- LEIs are yet to introduce CNCs in their workshops;
- The foundries and the workshops are not conversant with modern heat treatment and material testing;
- Though only a few LEIs have limited heat treatment facilities and conventional chemical testing laboratories for material testing, they are yet to introduce testing equipment like, Atomic Absorption Spectrometer, Computerized carbon and Sulphur Analyzer for material testing;
- LEIs have no facilities like Magnetic Crack Tester & Demagnetizer for crack detection, Metal Spectroscope, etc.;
- For lack of CNCs, Centre Machines, Three Dimensional Measuring Device etc., high quality precision jobs are not possible to be done in any LEI;
- For lack of modern testing machines and equipments proper material testing cannot be done in the LEIs or elsewhere in any organization in the country;
- LEIs yet to create modern die making facilities and at present they relay on makeshift arrangements with conventional workshop machines and tools for die making though only a few of them have conventional pantograph. They therefore, lack quality and acceptability even in the local market;
- LEIs need to introduce modern precision sheet metal stamping facilities for precision sheet metal works.

LEIs need upgradation and modernization for attaining quality and acceptability of their products. In Table-2 it has already been shown that most of the countries in Asia are supporting this sector through establishing various technical training centres with all modern machines and equipment.

SMEs are reluctant to buy and use modern technology, which they never used before and needs high level of skill to operate. Therefore, Bangladesh also needs to establish such facility center in the country to assist SMEs to acquire modern technology and upgradation of skills. The Centre should help SMEs in reverse engineering, product development and quality testing. Without such a facility center, skill development of SMEs in modern technology will remain as impossible as ever.

Apart from this the following LEI assistance group may be formed with adequate policy and material support to help LEIs in developing new products and upgrading the existing ones:

d. Bangladesh University of Engineering and Technology (BUET)

e. Bangladesh Machine Tools Factory (BMTF)
f. Bangladesh Industrial Technical Assistance Centre (BITAC).

LEIs in Bangladesh are yet to introduce modern machinery for precision jobs and without which export of spare parts/engineering products from Bangladesh will remain almost impossible. Besides, the country is yet to create much-needed modern die making and modern foundry shop facilities. So, there still exist profitable gaps to be filled up by SMEs with modern machinery and equipment, these are:

- Modern workshop with CNCs (list of machinery in Annexure 6).
- Modern die making shop with EDMs and CNCs (list of machinery in Annexure 6).
- Modern foundry shop with Atomic absorption spectrometer for alloy and composite material casting (list of other necessary machines are in Annexure 6).
- Precision sheet metal pressing workshop with hydraulic press and other precision machines.

Products of these LEIs, if established, will enjoy opportunities both in local and export market, taking advantage of the cheap labour and abundant gas resources (for foundries).

AGRO-PROCESSING

General Discussion:
In Bangladesh, most of the SMEs in agro-processing industries, use locally made conventional machines (Annexure-7). In almost all the rice mills, locally made traditional old types of husking machines, dryers and boilers are used by SMEs. Foraging, threshing machine and hydro-tiller, oil expeller, semiautomatic flourmill, tea processing machinery and spare parts, etc. are mostly locally made. Backers in SME sector use locally made conventional ovens and mixing machines for biscuits and bread making (Annexure 7). Farm Machinery and Post-harvest Technology Division of Bangladesh Rice Research Institute, has also developed some low cost farm appliances, which are widely used in rural areas. Manufacturing industries of agro-processing machinery are also belong to LEI group and are mostly located in industrial growth centres spread all over the country including industrial estates of BSCIC.

In Bangladesh people like their food prepared at home from staple ingredients. They use fresh vegetables and fruits, cereals and pulse that are simply milled and dried spices grinded in hand or motorized grinder. Even they like to process and preserve curds, butter, sauce, jam, jelly, pickles etc. at home. Therefore, most of the traditional industry stemmed from cottage scale operation basically for captive domestic consumption. Some of these cottage industries later became the small-scale industry. They depend mostly on locally made semiautomatic machines to reduce dependency on trained workers to avoid risk of investment due to their non-availability. This is the scene in South Asia and many other countries of the Asia-Pacific region. Therefore, developing indigenous machinery must be geared up. This will solve the problems of project cost for SMEs and improve the quality of end product. Repair and maintenance will be more accessible and affordable. But now the traditional foods are being gradually replaced by newer food. Even traditional food preparation is being made more convenient by processed food products. But the above-mentioned traditional/indigenous machines though acceptable and appropriate for the present purposes, need a lot of improvement for increasing their efficiency and productivity.

Hygiene and environmental considerations in some case are also very important factors (particularly for directly edible food processing machines), which need serious attention

while making such improvements. In doing so, it must be carefully noted that, technological advancement in production of such directly edible products is quite visible now. Companies started manufacturing and marketing aseptically packaged commodities by using extruders. One of the first to make an appearance was milk. Others, mainly belonging to the medium-scale industry that quickly adopted this new technology and many products like fruit juice, flavoured milk, drinks, Soya milk etc. made their appearance. Now, many industries learnt the use of modern instruments. For example, with single and twin screw extruders they are capable of producing fancy shapes and sizes, using special dies and controls on temperature, moisture, shear rate etc. But most of the indigenous industry is in the small-scale, which needs input of newer technologies and way to economize. Unless these input are provide quickly, they are going to be vulnerable to MNCs whose product are of high quality and cost effective. Local products sometimes have questionable safety aspects. Unless safety is improved, not just their international markets but also their domestic market will eventually diminish. In SMEs the workers themselves are often unaware of the safety and hygiene aspect of food manufacture[41]

Equipment can replace many operations that are at present carried out manually. This will make food safer and healthier. Safer food will also have greater shelf life. Although food irradiation has been in practice for more than 40 years, it is only recently the shelf life of many delicate products like spices and milk preparations (sweets etc) is being prolonged sufficiently using low temperature techniques and proper packaging, because these operations can minimize microbial load without destroying the flavour and aroma. If certain preservatives could be used, this can further prolong the shelf life by not allowing the fungi and microbial to grow and degenerate the packaged food. This helps to make export of these products to greater distances. This is an alternative to costly food irradiation process. But where preservative like ethylene dioxide (such as for spices) is not allowed, irradiation being a cold process, can replace this new preservation technique without loss of essential aroma of the products. An overview of non-thermal technologies in table form has been shown in Annexure 9.

A change in life-style in Bangladesh is now gradually visible due to quick urbanization of down towns and rural areas. The enhancement of TV networks, increase in overseas travels and introduction of foreign foods have contributed to change the food habits of the most urban people and even to some extent the rich rural masses. Due to preoccupations and time constraints of the urban dwellers, preserved and processed foods are becoming necessary to various degrees. TV channels are opening up direct access to consumers for new foods including the Western ones. Large number of consumer is enticed to try newer foods, which are opening up new markets. In addition since restaurants are generally expensive, convenient processed foods are preferred to be the best alternative. This new development in food habit is definitely creating a bright future market for processed and preserved foods. In the absence of any dependable statistics it may be said that, at present soft drinks have the largest market share of the consumer food market. Biscuits and breads occupy the next largest prepared food market of the country. Traditional agro-processing industries like rice, flour, tea, spice and pulse milling are almost in its saturation stage. Edible oil extraction and refining mills also exist at a saturation level. Sugar, though has a market, still kept in the public sector. But in Bangladesh there exists enough opportunity for high quality canning of local fruits, jam, jelly, pickles, chutneys, ketchup, etc and flexible plastic packaged (aseptically) milk and milk products, concentrated pulps and juices, bread and biscuits and plastic packaged dehydrated vegetables, hot spices, potato flakes, popcorn, fried pulses and nuts, etc.

Agro-wastes also offer business opportunities like feed and briquetting. Simple mixing barrel, pressing and drying machines (all locally made) are enough for a feed industry. Briquetting

industry needs machines like screw extruders and piston press. In Bangladesh these machines are all locally made. Biogas powered cogeneration system can produce 6kw power from biomass/agro-waste. The Asian Seiki co. Ltd. has recently developed its technology/machine (for details http://www.aist.go.jp.). The system is seen as a means of establishing small-scale biogas powered plant, which might find profitable use in Bangladesh particularly in rural areas where electricity has not yet been supplied.

Summery of Discussion:
Agro-processing and food are the most traditional sector in the country. They stemmed out mainly from cottage scale of operation and depend mostly on locally made machines. These machines are cheap and locally repairable. But they need improvements. The main limitations and advantages of SMEs in agro-processing are:

- Most of the machines used by SMEs in agro-processing are locally made (Annexure-7) and belong to LEI group of products.
- These machines such as threshing, foraging, boiler, dryer, husking, oil expeller, tea processing, rice mill, flour mill etc. are acceptable and are abundantly used by SMEs in Bangladesh;
- There is scope for improvement of efficiency and accuracy of these machines;
- Hygiene and environmental consideration in some cases are also very important factor (particularly for directly edible food processing machines), which need serious attention while making such improvements;
- Equipment can replace many operations that are at present carried out manually. This makes food safer, healthier and enhance shelf life;
- Instead of costly irradiation technology, low temperature techniques and proper packaging can be chosen for safety of food by minimizing microbial load and growth of fungi (Annexure-9);

This sector also needs various technical and R&D assistances. Following group may be formed with adequate policy and material support to help SMEs in developing/upgrading new products/existing ones:

d. BUET
e. Farm Machinery and Post harvest Technology Division, BRRI, Gazipur.
f. Food Division, Bangladesh Council of Scientific and Industrial Research (BCSIR).

Though traditional industries like rice mill, flourmill, tea processing, etc are almost saturated, new market opportunities are opening up with the change of life style and taste of the people. Large number of customer is now enticed by newer foods.
Agro-processing and food sectors now offer the following opportunities for the SMEs:

- High quality canning of fruits, jam, jelly, pickles etc.;
- Flexible plastic packaged (aseptically) milk and milk products, concentrated pulps and juices etc;
- Packaged dehydrated vegetables, fried pulses and nuts with spice etc;
- High quality bread and biscuit;
- Feed and briquetting from agro-waste; and
- Small-scale power generation (6K.W) from agro-waste by biogas powered cogeneration system.

ELECTRONICS

General Discussion:

In electronics the items required to be produced and their scale of production determines the type of production technology. At present, SME in Electronics are not using any automatic/robotic machine in their production line. These will not be appropriate, because of limited scale of production. Most of the Electronic industries in Bangladesh in the last decades were involved in assembling of consumer items like Radio, Television, Cassette recorder, etc. But the recent liberalization of import has put such industries in serious problem, though they still form the major segment of this sector. Assembly involves only stuffing, soldering of the given components in a kit. The Multinationals who started the assembly business in the country failed to encourage local integration of even PCBs and cabinets. Actually, the MNCs could not do so because of economic consideration and scale of production. However, they provided the country with some management and technical skills to operate electronic industry.

During the 1980s a few local entrepreneurs started designing their own circuits. Some also copied foreign circuits to develop electronic items for local consumptions. They could develop and design their own PCBs or even make some for others. Now in Bangladesh, a good number of enterprises are manufacturing items like Voltage stabilizer, P.A. Amplifier, Voltage Protector, UPS etc. for local consumption.

There is another group of entrepreneurs who could develop some items based on totally indigenous technology. They conducted R&D, prototype development and took necessary steps for marketing of research out come. Their products now cover quite a good number of areas, these are, (a) Consumer items, (b) Professional equipment/instruments (c) Micro-computer and microprocessor controlled equipment.[42] But they have problems like scale of production, finance and goodwill. These limitations and absence of local die making facilities never allowed them to produce their own cabinets in proper and attractive design. However, they make their cabinets by makeshift arrangements mostly from sheet metal or in locally made (using lathe, milling, grinding and pantograph) plastic moulds. Despite these impediments, they have been able to produce a good number of items (Annexure 10). Some of these items have been purchased by private and government enterprises. If proper supports including finance/venture capital are provided to these R&D oriented enterprises, a few of them may become successful entrepreneurs. Individuals at their own place of choice establish electronics industries in Bangladesh. Only a few could be accommodated in Electronics Complex of BSCIC in Dhaka.

The SMEs engaged in electronics, produce a limited number of items only targeting the local market needs. They therefore, rely on manual assembly and dip soldering techniques. But they lack in appropriate/costly testing equipment. They, of course, use normal testing equipment like AVO meter, oscilloscope, signal generator, computer, software etc for designing and assembly works. Most SMEs are not aware of any special testing equipment. Therefore, to help SMEs, advanced testing facilities are being recommended in the proposed Common Facility Centre. In India, similar Facility Centres are in operation under National Small Industries Corporation (NSIC) to support SMEs in research, product development and testing.

Electronics industry is now considered as a global industry and it is undergoing a process of worldwide restructuring. The process is having an impact on producers and users of electronics products. The developing country like Bangladesh therefore, should establish strategies oriented more towards promoting integrated development of the electronic industry and more coherent production system at the sub regional and regional level. Bangladesh should identify production complements and venture into regional subcontracting linkages

wherever is found profitable. The country can also take advantage of the global trend of relocation and FDI.[43]

Bangladesh should also explore the great possibility of the private R&D activities by providing finance/venture capital to the promising entrepreneurs. Both FDI and R&D activities will certainly provide Bangladesh with a greater platform to harness technology and support SMEs in electronics with a broad arena to venture and prosper. But this should be borne in mind that the intensity of local R&D activities and their success along with other government policy supports will help towards attracting FDI in the country, because MNCs are attracted to the economies where they find a pool of knowledgeable scientists and engineers.

The electronics industry is an extremely large and diversified industry with many strongly linked sub-sectors. This industry is one of the most internationalized industries with a wide range of niche markets and choice of production styles that offer opportunities of entry for most of the developing countries at different stages of development. Electronics holds great prospects for the future of Bangladesh as the talent and skills of the people are suited to this industry. The following are the areas of prospects of this industry at present considering the existing abilities and status prevailing within the country.

Basic component:
At present component like transformers, inductors, speakers, etc., which have reasonably high unit value and can be manufactured in small labour intensive establishment and without large investment can be produced. But components like resistors, capacitors, diodes, etc., which require large investment for automated production line and comparably less manpower is not feasible for local production. Moreover, their unit price is also very low and thus required to be produced in millions and involves large buyers and export markets (which are already filled up mostly by developed countries) for their consumption.

Integrated Circuit (IC) manufacturing/ packaging & VLSI design:
IC manufacturing is not an area of choice for Bangladesh for it is a high-investment and high-tech industry (as they are required to be produced on high-purity silicon crystal wafers). Only a few developed countries produce them for the whole global market. There is, however, an opportunity in IC layout deigning, known as VLSI designing. But it requires engineers in the production line and a group of scientists/engineers for their design works. Some fabrication facilities to make prototypes of the VLSI designs are also required. This enhances the investment cost**.** Though hundreds of ICs can be manufactured on a single silicon wafer and many developed countries manufacture them in other developing economies to reduce cost of labour, production of ICs in Bangladesh of its own will not be feasible for its marketing uncertainity. But this may be a good joint venture proposition in Bangladesh because packaging of IC is a labour intensive industry.

PCB design and manufacturing:
PCBs are widely needed in electronic industries to stuff electronic components on them. The local industries make their own single sided PCBs but they use screen-printing technology and cannot produce good quality PCBs. The double-sided PCBs required by modern microprocessor based circuits, which need through-the-hole plating techniques, are not produced in the country now. The assembly units, which use dip soldering in their assembly line, import the required PCBs with solder resist applied in their imported kits. Attempts were made in the past (in late eighties) to attract foreign buyers by setting up of PCB industry in the country but all such efforts eventually failed. As the local demand for PCB has been

increased substantially joint venture may now be tried for this industry both for local and foreign markets.

Cabinet Manufacturing:
All electronic products need a cabinet of their own. Cabinets must be properly designed and should have a conspicuous look. Generally, cabinets are made from sheet metal or plastic. In Bangladesh, there is no modern die making industry to make die for precision sheet pressing or for plastic molding. The local industries thus use only makeshift arrangements with lathe, milling, drill, etc to make dice and molds, which can only serve the purpose but not create an impression on the users. Modern die and mold making industry as proposed in light engineering sector above can solve the problem. Making die and molds from abroad is very costly. SMEs cannot effort to go for that and their present limited market need do not allow them to use such costly dice and molds.

Assembly of foreign kits and local-foreign mixed assembly:
Most of the electronic industries in Bangladesh fall in this category. There is no large-scale manufacturing industry but they produce only sufficient for the local market by importing complete foreign kits. These industries are gradually loosing their market recently against completely built-in imported items mainly from China. There is still another group who produce items like PA amplifiers, UPS, Voltage stabilizers, etc., using their own circuits and both locally made (components like transformers, cabinets, inductors, etc) and imported electronic components are now doing better than the kit assemblers. If tax incentives are provided to them, they will become a potential group of SME by expanding their business, and will be able to attract foreign companies by their skill and knowledge to invest in Bangladesh. The preset market demand for such items is not enough but sufficient to invest as a beginner.

Totally indigenous technology & assembly:
Some SMEs in Bangladesh are producing a few items (Annexure 10) based on totally indigenous technology. Though these items have only limited use in very specific areas, they are comparably more feasible than any other group of products. SMEs interested in electronics may choose to produce similar items initially for local consumption. These SMEs will be able to develop a base to produce a pool of engineers to attract foreign investors and a few of them may turn out as successful entrepreneurs in future. But in developing these SMEs appropriate government support including exemption of VAT and other taxes on imported components will be necessary. This should be done in order to encourage the new knowledgeable entrepreneurs to join business and invest more on R&D.

Computer and its Peripherals:
The growing demand of computers provides major potential for local production of its peripheral equipments such as disk drives, magnetic disks, printers, keyboards, etc. But for producing any of these items, joint venture will be a safe proposition.

Summery of Discussion:
SMEs in electronics are characterized by very small-scale operation targeting only the local market. Their product list is given in Annexure-10. At present they have the following limitations and advantages:

- Scale of production is very limited;
- Except small transformers and inductors no other components are locally made;
- Attractive and good quality cabinets (from plastic/metal sheet) cannot be produced locally for want of precision die making facilities in the country;

- Automatic assembly units are precluded by very small scale of production and dip soldering and manual stuffing technology are in practice;
- Consumer items like radio, T.V., cassette recorder, etc are assembled from 100% imported kits based on foreign circuits and these assemblers are now becoming uncompetitive;
- There are indigenous items developed through local R&D in the market. These are professional instruments and microcomputer/microprocessor controlled equipment;
- There are also items like P.A. amplifiers, UPS, voltage stabilizers, etc., which are produced using local and foreign mixed technology (i.e. by copying foreign circuits and using local/foreign components and local cabinets).

The SMEs who produce items based on their own R&D and also those who depend on mixed assembly (local and foreign) are doing better than the 100% kit assemblers. Though the present market demand for such items is not enough, it is sufficiently profitable for new investors.

This sector also needs various technical and R&D assistances. Following group may be formed with adequate policy and material support to help SMEs engaged in this sector for developing new products and upgrading the existing ones:

d. Applied Physics and Electronics Department, University of Dhaka,
e. Electrical and Electronics Department, BUET,
f. Institute of Electronics, Atomic Energy Commission.

The prospective scopes of investment for SMEs are:

- Local R&D based new items similar to those shown in Annexure-10. These items may also be exported if attractive cabinets can be designed and made locally.
- I.C. layout or VLSI designing by establishing fabrication facilities, including PCB and transformers, which are labour-intensive. But these are mainly joint venture propositions for ensuring marketing;
- Computer peripherals such as disk drive, magnetic disks, printers, key boards etc. But this also is a joint venture proposition to ensure marketing;
- Local and foreign mixed items similar to those shown in Annexure-10. These items may also be exported if attractive cabinets can be designed and made locally.

SOFTWARE

General Discussion:

As knowledge intensive technology, software is entirely different from other sectors. The production technology of software has a universal character. It cannot differ too much from place to place. It is computers and group of knowledgeable engineers that comprise a software company. The most important aspect is its ideal location and mode of communication. Other facilities such as international level accommodations in cluster or in a hub are necessary for developing this industry. Creation of such facilities is mostly dependent on the government programmes. Bangladesh is yet to develop any hub or cluster for encouraging software business. The country has of course, framed a National Information and Communication Technology (ICT) Policy in 2002, under Ministry of Science and Information & Communication Technology. The government has announced that an IT park will be established in Gazipur near Dhaka. An information technology village having multiphase facilities shall be established as part of infrastructure development for promotion

of export in this sector. Software and IT business has been exempted from income tax from 1st July 2002 to 30th June 2010 (Export Policy 2003-2006, Para 9.12.4.).

It is also expected that Bangladesh will be connected with the international highway of information through submarine cable soon (Bangladesh T&T Board is implementing a project for this purpose). In addition BTTB should set up ISDN lines and a fibre optic backbone all over the country. BTTB should also set up high-speed data and voice communication link with all countries that may be the potential buyers of software. Usually a software company needs 2 megabyte line to develop and export software but now it can only avail a mere 64 kilobyte line, a thousand times less than the required capacity. The present facility is not even enough to handle data transmission. Permission from BTTB to get a connection to this narrow bandwidth line is also very cumbersome and prohibitively costly. The government has given permission to only 7 VSAT companies as selected by BTTB, which limited the choice of the user only to encourage monopoly. The consequence is counterproductive for software companies.

Software and IT attract SMEs the most, as this business requires relatively small capital investments. Global shortage of skilled manpower is now reported everyday. The global shortage of software skills can be seen both a threat and an opportunity for SMEs specializing in software. Shortage is also felt in India, which is a traditional supplier of high quality software to the world market. According to a forecast employment in software industry could grow from about 250,000 in the year 2000 to 2 million in 2008 in India, if training could be provided in the quantity required.[44] But with so much of growth potentials, SMEs are constrained by economic, culture and networking factors to easily venture into this business, apart from all other problems related to knowledge ware and hardware. National and international networking can help to overcome some of these barriers.

Internet services commenced in Bangladesh in 1994. Since the deregulation of VSAT, the Internet Service Provider (ISP) business and the number of Internet users have been booming. At present around 100 private ISPs operate in the country and have over 550,000 users. Hardware is still the most dominant IT sub-sector in the country. Bangladesh has no hardware-manufacturing unit. All the hardware accessories are imported. In 1998, after the government exempted all taxes on hardware accessories, hardware sale began to increase significantly. There are more than 1000 small-scale computer firms that are ready for hardware integration. These companies reflect the large number of hardware engineers and system integrators in the country. Foreign investors would find opportunities to establish such industries in Bangladesh, particularly in the Export Processing Zone (EPZ). Manufacturers from Korea have already established themselves in the EPZ, Chittagong. This is a unique example of FDI, which hopefully will contribute to the growth of local SMEs for service and for local integration of spare parts. Bangladesh has offered tax holiday for the software and data processing industry. To develop the ICT sector an incubator centre called Grameen IT Park was formed by a renowned NGO of the country.

Software development provide special opportunity since, unlike the central processing unit and other hardware in computers, software production is primarily labour intensive, it require personnel to write programmes relevant to national needs and export requirements. SMEs in Bangladesh have already made a humble beginning in this sector. Till date 121 of them have started to produce software covering different areas and more are expected to join in future. ICT Business Promotion Council has also been formed under the Ministry of Commerce with Secretary, of that Ministry as its chairman. It has been reported that already they have able to export software to 23 countries around the world.

Actually, software business can best grow based on its local consumption. Once software is packaged it needs continuous improvement according to customer's changed requirements. Good software companies thus always receive feedback from customers to debug their software and continue improving them to customer's full satisfaction. It is in this context, the local consumers are the best promoters of local software companies because they can be the most suitable and convenient source to provide such feedback, which a foreign user may not like to do too often. Thus to encourage the local software firms it is necessary to ban use of pirated software in all organizations both public and private. All public sector organizations should be given due resources to replace the manual systems of documentation and record keeping by computerized system through the use of locally developed customized application software.

Electronic commerce is an important driver in software business. The best opportunities for SMEs specializing in software are in software maintenance. SMEs know the local business culture and the best of them show exceptional dedication to the needs of their clients. The demand for software service can be expected to continue its growth as the Internet is turning all sorts of companies into publishing houses and electronic commerce is creating exciting international business opportunities. Wireless e-commerce is also emerging as a new area for software business.

In commercial software retail products, the law of increasing returns prevails within each market niche, the bigger the market share the more customers likely to have in the future. This tendency is dedicated to people's need to interact. As it is difficult for each buyer to directly compare software products, buyers tend to choose the safety of numbers and select the product that is the most popular.[45] For these reasons, as a commercial software developer one has to either set the global standard in his market niche or perish. In package software the opportunities of SMEs are defined by their ability to find application areas that are commensurate with their skill profiles and generate enough income to make their presence in the market economically viable.

In India, for a 64KB connection the monthly charge is only around 2000 USD as against 8000 USD in Bangladesh. Moreover, in India the choice was never made limited, instead there are enormous opportunities for selecting the most suitable connection. It is for this high cost of connection charge the software companies in Bangladesh often complain that they are finding it difficult to attain cost competency in international market. What Bangladesh needs to do is develop low cost IT access. The costly PCs may be replaced with cheap 'network computers' and private sector should be allowed to set up own satellite communication. It has been recently reported that Bangladesh T&T Board has signed an agreement (on March 27, 2004) with a company in Singapore for connecting the country with submarine cable providing a 10 GB bandwidth, which will help mitigate a longstanding problem.

Summery of Discussion:
Software is a knowledge intensive industry and its production technology has a universal character? it is computers with a group of skilled engineers. Software attracts SMEs the most, because it requires relatively small capital. Bangladesh is a new comer in this billion-dollar business. So far SMEs in Bangladesh have been able to export their software to 23 countries around the world. But they are facing the following problems:

- Development and export of software need 2 Megabyte line but instead only 64-kilobyte line is available in the country.
- In Bangladesh a 64 kilobyte line costs 8000 USD per month as against 2000 USD in India.

- Only 7 VSAT companies have been selected by BTTB, which made the choice and options very limited for the entrepreneurs.
- Bangladesh is yet to be connected with submarine cable,- the international high way of information.
- BTTB has no high-speed data and voice communication link even with potential buyer countries and also no ISDN and fibre optic network all over the country.
- The country has no IT Park/Village with suitable infrastructure and international standard accommodation to encourage software business.
- Availability of pirated software and absence of policy and resource allocation for public sectors to use locally developed customized application software.
- Absence of effective policy for HRD in Computer/IT.

Apart from creating the above facilities and mitigating the impediments already discussed, the country needs to do the following for the growth of the sector:

- Creating a special fund for giving loans to teachers and students of this sector on affordable terms without bureaucratic hindrances;
- Creating special fund for supporting R&D on IT/Software;
- Implementing the agenda of ICT Business Promotion Council expeditiously;
- Strengthening and upgrading Bangladesh Computer Council (BCC) for (a) providing high level need-based training, (b) creating fund for supporting R&D in IT, (c) establishing central resource center and database of related matters, (d) encouraging IT industries to take steps for intellectual property and ISO certifications etc.

An R&D assistance group on software and IT may also be constituted with the following organizations supported by adequate policy measures:

d. Computer Science Department, Dhaka University;
e. Computer Engineering and Science Department, BUET;
f. Bangladesh Computer Council (BCC).

Bangladesh can become a potential source of software and data processing services to the overseas markets. But for this to happen the impediments should be mitigated and facilities should be created. Software business may initially be targeted at its low-end segments like data entry, medical transcription, answering services, etc. but gradually the business should be targeted towards R&D based software.

CONCLUSION BASED ON ABOVE ACCOUNT AND INTERNATIONAL EXPERIENCE:

SMEs contribute significantly to the development process and economic growth of the country but they are facing many limitations and challenges. In the age of market and trade globalization SMEs need to strengthen their technological base to make themselves competitive. SMEs need more than money to update themselves to be able to take the impending challenges of the 'level playing field'. They need other supports in specialized areas, which they cannot develop in-house, such as management, marketing, accounting and MIS, e-commerce, etc. It is obvious that SMEs alone cannot achieve them; they need government, regional and international assistance to be able to demonstrate their creativity in the national economy. The following suggestion may be considered:

WHAT SMEs SHOULD DO?

- SMEs, in the present context, should not exclude modern and sophisticated technology while considering the much-needed appropriate technology for them. Appropriate technology should be understood as a dynamic technological concept and not just as a policy of manufacturing low-cost traditional items. Man and machine can work together (in contrast to the most advanced automated systems) to bring out products with more flexibility and which are consumer oriented[46].
- SMEs operate in a very competitive world. SMEs must therefore be creative and innovative and continuously keep on improving their technology and operations.
- SMEs must be able to take benefit of new processes, technologies or new ideas of production, marketing and management or accounting developed elsewhere around the world.
- SMEs must improve their ability to select right technology and right strategy and understand the process of technology transfer and technology assessment.
- SMEs must take advantage of the global technology transfer opportunities, as they need to harness technology at a lower cost to enhance their national and international competitiveness.
- SMEs must take advantage of the Intellectual Property Portals (IPPs) and other services provided through the Internet, as they are very useful for technology transfer and other aids at a reasonably lower cost and minimum time.
- SMEs must train their manpower to be able to operate skill-intensive activities as the increased technology intensity of products is quickly reducing the importance of primary and simple low technology activities.
- SMEs must build up Indigenous Technological Capacity (ITCs) through the process of Learning by Doing. The process of Learning by Doing is central to incremental innovation and technological change. It has been pointed out that engineers on the shop floor play a vital role in supporting the operator's effort to acquire new skills and come up with new ideas[47]. The studies show that Learning by Doing and entrepreneurial capabilities have been instrumental in strengthening humanware and technoware at the enterprise level[48].
- SMEs must continuously upgrade their technological capabilities in order to attract the MNCs to transfer technologies for mutual benefit and also for FDI.
- SMEs must be able to make social adjustments through up gradation of skill and technology absorption to take advantages of modern production processes and through production and marketing of newly developed/innovated items.

WHAT THE GOVERNMENT NEEDS TO DO?

SMEs are a primary target for many countries desiring to stimulate economic growth and development. Given their smaller size and limited resources, however, they usually lose grounds to large enterprises. SMEs have little time or money to engage in or conduct R&D or to try to access technology even in their own government laboratories or universities unless the government gives them the necessary assistance. Therefore, governments should establish/launch facility centres/programmes that aid SMEs in doing business and creating technology transfer so that can contribute to the country's overall prosperity. In framing/establishing any such programmes/centres, the problems faced by SMEs in acquiring modern/appropriate technologies must be addressed for increasing their competitiveness in the international market. It is imperative to create an environment conducive to them, which should include:

- Formulation of appropriate policies and programmes;

- Setting up of industrial and technology Parks/Clusters to promote sourcing of new technology, innovation and transfer;
- Organizing local level information services, data banks and seminars in collaboration with professional bodies;
- Strengthening of R&D Organizations and research facilities in educational institutes and universities;
- Strengthening/establishing training centres for human resource development;
- Strengthening utility services, (telephone, electricity, gas and water supply system);
- Promoting strategic alliance with R&D institutions, universities and other enterprises at national, regional and international level;
- Sending experts to SMEs to assist them with the introduction of new technologies;
- Establishing business centres;
- Arranging financial resources on affordable terms and in a non-bureaucratic manner;
- Improving and securing access to advanced technologies;
- Strengthening linkage between R&D and educational institutions/universities;
- Access to technology data bases and knowledge flow; and,
- Creating and strengthening the local innovative system.

A set of policy principles and area of activities emerges from the above findings. Of course, the implementation of these principles will depend on the availability of resources required and commitment of the policy makers concerned. These strategies and policies has been prioritized as short run, mid run and log run suggestions as follows:

A. Short Run Suggestions:

1. **Definite Policy for SMEs:** Bangladesh should have a separate policy for SMEs aiming at reduction of regulatory burden, neutralizing policy-induced constraints, creating SME friendly environment and developing a real private-public sector partnership. There should be an acceptable definition for SMEs under a standard industrial code.
2. **Financial Supports to SMEs:** DFIs, commercial banks and NGOs may further increase their financial supports to SMEs on affordable terms and at lower interest rate.

3. **Seed Money, Venture Capital and Investment Funding:** Financial facilities like seed money, venture capital and investment funding should be improved. Long-term loans should be made available to SMEs.

4. **Thrust Sectors:** Some prospective sectors like light engineering, IT, agro-supportive and agro-processing, cottage and handicrafts, electronic, cosmetics, etc. may be declared as thrust sector and given due priority for their development by providing necessary support services.

5. **Entrepreneurship Training:** Entrepreneurs in SMEs crucially need training on management, marketing, accounting, technology, IT and e-commerce. At present there is no such organization except Small and Cottage Industries Training Institute (SCITI) of BSCIC and BMDC. In a country like Bangladesh where entrepreneurial initiative is rare and shy the importance of such institutes need not be overemphasized. SCITI should be strengthened and its course curricula should be modified according to the needs of the present global business perspective.

6. **Conducting survey on thrust sectors:** Full-scale survey should be conducted separately on each sub-sector belonging to thrust sector for assessing its modernization needs, exploring the export potential and requirement of technology.

7. **International financing:** There are various international agencies that extend financial supports to SMEs. These sources should be properly explored and made accessible to SMEs. SMEs should be aware of these funds.

8. **Assistance for SMEs;** Training for SMEs for participating in the trade fairs in and outside the country may be arranged regularly by EPB. They should keep an inventory on prospective export items, identify foreign buyers and assist SMEs to establish contact with them.

9. **Technical Assistance:** BSCIC should provide technical assistance to SMEs particularly to SCIs in their pursuit for new technology. For this purpose BSCIC must maintain an inventory of appropriate technology and production processes to make them available to SMEs. BSCIC must prepare up to date industrial profiles on potential industries. SME**s should be aware of the present facilities of technical assistance**.

10. **Submarine Cable and Satellite Communication:** The country should be connected to international highway of information,? the submarine cable. Installation of satellite communication facilities should be given in the private sector for its rapid development.

11. **Establishment of IT Park/village:** Industrial clusters like IT parks/villages form a kind of knowledge network, where there is a constant sharing of knowledge and the benefits. So, software and electronics can grow better in such clusters. Bangladesh, therefore, should establish IT Parks/Villages.

12. **Exemption of Tax & VAT on Import of CNC machines:** Import of all types of CNC machines should be exempted from Tax and VAT. This will encourage SMEs to acquire modern computerized machinery, which are essential for their upgradation/competitiveness.

13. **Exploring Market Opportunities and E-Commerce:** Through E-commerce SMEs should explore foreign markets through greater trading cooperation with other countries. Advantages of E-commerce must be explored to identify new market opportunities. Growth of business both in and outside the country, at a minimum time and cost is now possible through Electronic commerce. SMEs should relay more on e-commerce to obtain information about their probable buyers and suppliers of raw materials and technologies. SMEs must have access to worldwide information network through Internet. Chambers, BENSDOC and BSCIC can hoist website for SMEs on their potential items. This will help SMEs to find new market opportunities. This service can also be used for identifying the foreign sources of technology and raw materials.

B. Mid Run Suggestions:

1. **Inter-Farm Linkages and Subcontracting:** Subcontracting exchange programmes may be launched among small and large enterprises both in and outside the country by promoting SMEs with all necessary support services. A Cell in the National Chambers may be opened to pursue the programme. Also BSCIC should continue it's affords to implement the subcontracting programme in the way it is being done now.

2. **Establishment of a separate Micro Bank:** For effective and exclusive service to SMEs a separate Micro bank may be established with all necessary expertise to appraise and evaluate loan proposals for SMEs. The bank should be free from bureaucratic hindrances.

3. **Private and Public sector cooperation:** Intra-organization cooperation is a prerequisite for R&D and innovation in SMEs. It is also essential for information dissemination on technology and business. S&T policy should provide necessary guideline to this end. Traditionally the government agencies have bureaucratic tinge and can hardly extend effective supports to SMEs. Therefore, reorganization of these agencies has for long been overdue. The objective behind public-private sector partnership would be to utilize the present strengths of both partners together and thereby overcome the limitations/impediments of growth.

4. **Technical Training courses for SMEs:** Technical training courses should be arranged for SMEs. BSCIC should develop all it's 13 skill development centres in the country with modern equipment and at least one of them should be upgraded to the level similar to Hi-Tech Vocational Training Centre in India (Annexure-5).

5. **BSCIC to be Reorganized:** BSCIC should be reorganized with properly trained technical manpower in a way so that it can help SMEs to grow according to the needs of the changed perspective. It should follow the way NSIC in India developed. BSCIC should help the modernization of SMEs to meet the challenges of global competitiveness. Alternatively, an organization like SMIPC in Korea may be established aiming at the desired growth and modernization of SMEs in the country.

6. **ISO Standards (Quality assurance and Environmental friendliness):** ISO 9000 and ISO 14000 has been there to ensure compliance of quality assurance and environmental friendliness. Entrepreneurs of SMEs must be trained in phases to convince them to comply the set rules of ISO Standards. BSCIC with support from BSTI and Department of Environment can organize training courses on Standards and environment for the entrepreneurs.

7. **Trade Fairs, Exhibitions, Seminars and workshops:** Programme like trade fairs and exhibitions for promotion of marketing and seminars and workshops etc. on SME issues related to their problems and needs should be organized on regular basis. EPB and BSCIC have a definite role to play in this regard. Chambers around the country also can arrange these programmes. For promotion of SME competitiveness proactive policy needs to be pursued. SMEs must be made aware of the impending challenges of globalization. SMEs must also be provided with enough information and assistances to make them able to face the challenges. They may be required to be upgraded with

finance, training, technology, skills, market information, management tools etc.

8. **Inter-linkage among SMEs:** The need areas for inter-linkage should be identified on the basis of extensive survey on major SME sub-sectors/thrust sector. This will help finding out ways appropriate for promoting effective cooperation/subcontracting among SMEs in the country.

9. **Common Facility Centre:** SMEs are reluctant to buy and use modern technology particularly, which they had never used before and needs high level of knowledge and skill to operate. Therefore, in many countries government agencies are establishing various facility centres to train and support SMEs in modern technologies. Bangladesh must establish such facility center to assist SMEs in modern technology, skill upgradation, reverse engineering, product development and quality testing.

10. **Technology Incubation:** Country's technology policy should include technology incubation as an objective. Universities and research organizations should be strengthened and their laboratories should be modernized to be able to conduct effective R&D for industrial needs and product development. In this afford assistance of such intergovernmental organizations, as Asian and Pacific Centre for Transfer of Technology (APCTT) may also be sought.

11. **Introducing new need-based Subjects in Universities:** Technology development in any country depends on its education system. Modernizing education curricula including introduction of new subjects aiming at industrial development should therefore be undertaken. All engineering colleges and universities should open new departments like, Mechatronics, Electro-mechanical Engineering and introduce new subjects like, Composite and nano-material science and Micro electro mechanical system (MEMS). For example, Atomic and Molecular Nano Technology can be introduced in Applied Physics/ Physics/Applied Chemistry departments of all universities. Composite and Nano material science can be introduced in Metallurgy and material science department of BUET and other science and technology universities of the country. But appropriate fund must be allocated to equip the laboratories and workshops with adequate number of modern equipment and machinery.

C. Long Run Suggestions:

1. **Technology Assessment, Diffusion and Dissemination:** Technology assessment is a prerequisite for selecting appropriate technology, and than its acquisition, diffusion and dissemination can follow. Properly assessed and acquired technology and know-how from advanced economies could be an important part of developing R&D capacity in Bangladesh.

2. **Expansion and Diversification of SMEs:** Growth of SMEs is essential for industrial expansion of Bangladesh. For this purpose enough support services are to be provided to the existing SMEs in order to make them competitive and setting up of new industries are to be encouraged at all levels. In order to do this modernization of existing industries and identifying new areas of investment followed by effective financial and technical supports should be undertaken.

3. **Improving Production Structure of SMEs:** Production structure of SMEs must be flexible and dynamic to be competitive in both domestic and foreign markets. They can change their machinery and add new plant relatively at a low cost due to their small size. Also they can retain their work force in new technology by providing orientation and training at a minimum cost and time. But financial and other supports are essential for desired modernization of SMEs to change into a flexible production structure from its traditional status.

4. **Conducive Infrastructure Facilities:** Electricity, telephone, gas, water supply connections to be given on priority basis, which will require installation of enough generation and supply network for their stable and uninterrupted supply. A well planned national policy and political commitment would be required to implement the programme.

5. **Cottage industry Development:** There are now many NGOs working for the development of cottage industries and BSCIC has been there since 1957. The potential strength of cottage industry lies in its wide dispersal and variety having a traditional flavour and aesthetic. It has entered the foreign market, though in a very small way. But it has enough scope for growth. Design Centre of BSCIC with its limited resources is contributing for the development of this sector. But the Centre itself needs upgradation. They should introduce CAD/CAM for developing and disseminating new designs to the entrepreneurs. It should also develop technologies for preservation, attractive finishing etc of handicraft items.

Closing Remarks: Appropriate technology aims at development, and from a development standpoint distinction between high and low technology are irrelevant[50]. What is important is that the product or services is useful, it is friendly to society and the environment, and it contributes to the overall priorities of economic growth, social justice and employment. Appropriate technology for SMEs must be seen in the light of such development process. The same thought has been followed in the preparation of this paper and in framing the above suggestions aiming at development of SMEs and the industrial sector as a whole in the country. All views expressed in this paper are personal and without prejudice to any individual, groups and organization that might have been mentioned in this document.

REFERENCES:

1. **Parvis Asheghian and Bahman Ebrahimi, 1990, 'International Business', New York; Harper & Row p 291.**
2. **Iqbal Mahmud and Muhammad Munirul Islam, ILO/UNDP project BGD/79/028. 'Human Resource Development and Employment Generation', Dhaka, March 1982, p. 1.**
3. **Report of The Ministerial Level Meeting, International Forum on Appropriate Industrial Technology. UNIDO Monograph on Appropriate Technology, United Nations, N.Y. 1979.**
4. **Keith Marsden, 'Progressive Technologies for Developing Countries', Essays on Employment' ILO, Geneva, 1971.**
5. **Dankbaar, B. 1998, 'Technology Management in Technology-Contingent SMEs', International Journal of Technology Management, 15 Nos, ½ pp 70-81.**
6. **Market L.R., 1993, 'Contemporary Technology: Innovations, Issues and Perspectives', South Holland, Illinois: Goodheart Willcox.**
7. **Rogers, E.M. 1995, 'Diffusion of Innovations', (4th ed.), New York: Free Press.**
8. **Rogers, D.M.A. 1993, 'Knowledge Innovation System: The Common Language', Journal of Technology Studies, 19(2), pp. 2-8.**
9. **Sharif, M.N., 'Technological Substitution Models in Renewable Resources: A Systemic Approach' (Campos Lopez, Ed), New York, Academic Press 1980.**
10. **Rogers, E.M., 'Diffusion of Innovations' New York: Free Press, 1962.**
11. **Horusby. J., 'The Story of Innovation', London, Weidenfeld and Nicolson, 1977.**
12. **Gray. E. et. at, 'Growth and Its Implications for the Future', Connecticut, Dinosaur, 1975.**
13. **'Global Study of World Electronics', UNIDO, 1988, p.108.**
14. **Jorma T. Lievonen, 'Innovation Opportunities from Fusing High Technology' Asia Pacific Tech Monitor, Sept.-Oct. 2000, pp. 22.**
15. **Jorma T. Lievonen, 'Innovation Opportunities from Fusing High Technology' Asia Pacific Tech Monitor Sept.-Oct. 2000, pp.27.**
16. **Kelvin W. Willoughby, 1990, 'Technology Choice' Boulder, Colo. Westview, Press pp. 273-284.**
17. **Melanie Jones and Ravi Jain, Technology Transfer for SMEs: Challenges and Barriers', International Journal on Technology Transfer and Commercialization, Vol. 1, Nos ½, p. 150.**
18. **'Process de trabojo' by J.C. Neffa, Buence Aires, 1988.**
19. **David A. Nadler and Michael L. Tushman, 'Implementing New Designs: Managing Organization Changes', p. 604-605, and 'Managing Strategic Innovations and Changes: A Collection of Readings by Michael L. Tushman and Philip Anderson, Oxford University Press, 1997.**
20. **Daniel Rouach, 'Technology Transfer and Management', Asia Pacific Tech Monitor, May-Jun 2003, p. 23.**
21. **C. H. Cheng, L.Y.C. Hsiao and C.J. Tasi, 'High-Tech Industry in Taiwan: Support for High-Tech Ventures', Asia Pacific Tech Monitor Nov-Dec. 2002, p. 35.**
22. **Jeff Saferstein and Daniel Rouch 2002, 'Creating Regional Wealth in the Innovation Economy: Models, Perspective and Best Practices', F.T. Prentice Hall, pp 283-284.**
23. **Taeho and Hwy Cheng Moon; 'Globalization of Technologies', Asia Pacific Tech Monitor, Jan-Feb. 2002, p 23.**
24. **Rugman. Alan M. 1991, 'Dimond in the Rough', Business Quarterly. 55(3), p 61-64.**
25. **Ahmad. S. Through direct interview with the entrepreneurs of LEI and Foundry shops during sample survey for preparation of study reports.**
26. **Ahmed M.U., Mannan M.A., Razzak A., and Sinha A., 'Taking stock and Charting a Path for SMEs in Bangladesh', Bangladesh Enterprise Institute (BEI) January 2004, p. 4.**
27. **Ahmad. S. Through direct interview with the entrepreneurs of food and subcontracting industries during sample survey for preparation of study reports.**

28. Bureau of Economic Research, University of Dhaka, 'Entrepreneurship Development for Small and Medium Enterprise'.
29. Bakht Z., 2001, Bangladesh Institute Development Studies, Dhaka.
30. Ahmed M.U., Mannan M.A., Razzak A., and Sinha A., 'Taking stock and Charting a Path for SMEs in Bangladesh', Bangladesh Enterprise Institute (BEI) January 2004, p. 5.
31. National S&T Policy, S&T Division, Ministry of Education, GOB, Feb. 1986.
32. Study on Technology Transfer and Development, (Final Report, Vol. 1), Planning Commission PWPA, GOB, April 1985.
33. Ahmed M.U., Mannan M.A., Razzak A., and Sinha A., 'Taking stock and Charting a Path for SMEs in Bangladesh', Bangladesh Enterprise Institute (BEI) January 2004, p. 6.
34. Kharbnda V.P. 'Industrial Cluster' Asia Pacific Tech Monitor Sept-Oct. 2000, p.39.
35. Kharbnda V.P. 'Industrial Cluster' Asia Pacific Tech Monitor Sept-Oct. 2000, p.37.
36. Agarwal S.P., 'Role of Consultants in R&D and Innovation' Asia pacific Tech Monitor Sept-Oct 2000, p. 41.
37. Kharbnda V.P. 'Industrial Cluster' Asia Pacific Tech Monitor Sept-Oct. 2000, p.36.
38. Eastham T.R. 'Entrepreneurship in Hong Kong', Asia Pacific Tech Monitor May-Jun 2003, p. 39.
39. Lalkala R. 'Technological Innovation', Asia Pacific Tech Monitor Sept-Oct 2000, p. 20.
40. Ahmed .S., 'Case Study on Engineering Industry', (in Bengali), BSCIC, Dhaka, 1995.
41. Ahmed. S., Kamaruddin K.M. 'Food Industry', (in Bengali), BSCIC, Dhaka, 1995.
42. Rabbani K.S. 'Problem and Prospects Of Electronics Industries in Bangladesh', Journal of Bangladesh Electronics Society, 2003.
43. Ahmed. S. 'Prospect of Electronic Industries in Developing Countries Based on production Trends and growth pattern', Journal of Bangladesh Electronic Society, 2003.
44. Chandakera, Naiv, 2000, 'Shaky Telecom Threatens India's Software Growth' Electronic Engineering Times, 1994, 3, January, p.26.
45. Hoch Detlev, J. Cyriac, R. Roeding, Gert Pukert, Sandro K., Linder and Ralph Mullev, 2000 'Secrets of Software Succes', Harvard Business School Press.
46. Brandt D. and Cernetic J., (1999), 'Developing, Implementing and Assessing Human-Centered Control and Information Technology', Paper presented at 14th World Congress of International Federation of Automatic Control. Beijing, China, July 5-9.
47. Okada K., (1983), 'The Role of Engineers in Japanese trade and Industry', 1, p. 23-26.
48. Bowonder B., Miyake T (1988), 'Measuring Innovation of n Industry: An Analysis of The Electronic Industry in India, Japan, and Korea', Science and Public Policy 15, p. 279-303.
49. Kharbanda V.P., 'Industrial Cluster', Asia Pacific Tech Monitor, Sept-Oct. 2000, p. 39.
50. Lalkala. R. 'Technology Innovation', Asia Pacific Tech Monitor, Sept-Oct. 2000, p. 16.

Annex-1

List of government-funded research institutes in Korea

Government-funded research institutes/ year founded	Key research area	Contact for technology transfer
KRCF (Korea Research Council of Fundamental Science & Technology), 4 Institutes		
KIST, 1966 (Korea Institute of Science and Technology)	Multi-discipline	Kong B. Park jxpark@kist.re.kr
KRIBB, 1985 (Korea Research Institute of Bio-science and Biotechnology)	Biotechnology	Won S. Chung chungws@kribb.re.kr
KBSI, 1988 (Korea Basic Science Institute)	R&D equipment	Yung I. Kirn yikim@kbsi.re.kr
KAO, 1986 (Korea Astronomy Observatory)	Astronomy	Tae Y. Kwon tykwon@kao.re.kr
KOCI (Korea Research Council for Industrial Science & Technology, 7 Institutes		
KITECH, 1989 (Korea Institute of Industrial Technology)	Industrial technology	Kap S. Kirn kimks@kitech.re.kr
ETRI, 1976 (Electronics and Telecommunications Research Institute)	Electronics & Telecommunications	Eunl.Jang jangek@etri.re.kr
KFRI, 1987 (Korea Food Research Institute)	Food technology	Sung C. Park chai@kfri.re.kr
KIMM, 1976 (Korea Research Institute of Machinery and Materials)	Machinery & materials	Seung W. Park Psw@kimm.re.kr
KRICT, 1976 (Korea Research Institute of Chemical Technology)	Chemical technology	Inn Y. Park Iypark@krict.re.kr
KERI, 1976 (Korea Electrotechnology Research Institute)	Electro technology	Key Y. Hwang Kyhwang@keri.re.kr
KIOM, 1994 (Korea Institute of Oriental Medicine)	Oriental medicine	Byung K. Jeon sysop@kiom.re.kr
KORP (Korea Research Council of Public Science & Technology), 8 Institutes		
KICT, 1983 (Korea Institute of Construction Technology)	Construction technology	Tae M. Park tmpark@kict.re.kr
KORDI, 1973 (Korea Ocean Research and Development Institute)	Ocean technology	Bo Y. Kirn bykim@kordi.re.kr
KRISS, 1975 (Korea Research Institute of Standards and Science)	National standards	KuY Kim kim900@kriss.re.kr
KIER, 1977 (Korea Institute of Energy Research)	Energy technology	Deok K. Lee deokk;@kier.re.kr
KIGAM, 1976 (Korea Institute of Geoscience and Mineral Research)	Geoscience	Mun H. Kirn mhkim@kigam.re.kr
KARI, 1989 (Korea Aerospace Research Institute)	Aerospace technology	Jeong N. Cho jncho@kari.re.kr
KRRI, 1994 (Korea Railroad Research Institute)	Railroad technology	Se H. Lee shlee1@krri.re.kr
KISTI, 2001 (Korea Institute of Science and Technology	S&T Information, Technology transfer	Sang D. Park Psd7680@kisti.re.kr

Information)		

Source: Asia pacific tech monitor, Jan-Feb, 2003, P.49

Annex-2

Market segments-technologies and buyers

Institutional Inventions	All technologies	Clients/industrial sectors	Year
Knowledge Express	www.knowledgeexpress.	University & Industrial	1991
Pax Technology Transfer	com	Industrial & University	1997
Enterprise Development	www.pax.co.uk	University & Industrial	Jul-98
Corporation	www.teonline.com		
Patent & Licence Exchange		University & Industrial	Jan-99
Brain Supply	www.pl-x.com	University & Industrial	1999
Intellectual Property &	www.brainsupply.com		
Technology Exchange		University & Technology	Jul-99
University Ventures Inc	www.techex.com	University & Technology	Oct-99
yet2.com	www.uventures.com	University & Industrial	Feb-00
Licence Store	www.yet2.com	University & Industrial	2000
PricewaterhouseCooper's	www.licensestore.com	All	
	www.ipex.net		
Specific Market Focus			
Biofind Ltd	www.biofind.com	Pharmaceutical	1997
Pharmalicensing	www.Pharmalicensing.co	Pharmaceutical	Feb-99
Chemical Partners	m	Industrial	Nov-99
Ballantyne Ross	www.chemicalpartners.c	Pharmaceutical	2000
Qxhealtn	om	Pharmaceutical	-
	www.pharma-		
	transfer.com		
	www.qxhealth.com		
All Forms of IP			
IP Market Place	www.ipmarketplace.com	All	1999
Whatshotnow	www.whatshotnow.com	Brand names	Jul-99
Notary	www.notara.com	Brand names	Nov-99
IP Network	www.lPNetwork.com	All	Dec-99
Fast Trends	www.fasttrends.com	Brand names	2000
InventNet	www.lnventNet.com	Independent Inventors	1995
InventNet Internationa l			
Corporation	www.ii-corp.com	Independent Inventors	1998
PatentCafe	www.PatentCafe.com	Independent Inventors	Feb-99
Patentauction	www.patentauction.com	Independent Inventors	Jun-99
PatentPost	www.patentpost.com	Independent Inventors	Aug-99
ThoughtStore	www.thoughtstore.com	Independent Inventors	Nov-99
Patented Products	www.patentedproducts.c	Independent Inventors	
Inventionsforsale	om	Independent Inventors	
	www.inventionsforsale.c		
	om		
All forms of IP			
Knowledge Exchange	www.knexa.com	All	Sep-99

Auction Technology Exchange	www.technologyxchange .com	All	Aug-97
IP resources and solutions			
Technology Connect (Match-maker for resources) Hello Brain (Match-maker for problem/ solution) Think Mart (Match-maker for resources) Euro-technology Japan KK	www.technologyconnect. com www.hellobrrain.com www.thinkmart.com www.eurolicensing.com	Telecommunications All All Telecommunications	1999 Dec-99 May-99 2000
Tools for the IP professional			
Aurigin (Software products & Consulting) IBM IPN (Search, Resource, Marketing)	www.aurigin.com www.patents.ibm.com	All All	1992 Jan-97

Source: Tech Monitor * Mar-Apr., 2001, P.17

Annex-3

List of R & D and Scientific Organizations

Sl. #	Name of Organization	Designation of Head and Address
	Agriculture:	
1.	Animal Husbandry Research Institute	Principal Scientific Officer, Ram Mala, Comilla
2.	Fresh Water Aquaculture Experimental Station	Chief Scientific Officer, Mymensingh.
3.	Bangladesh Agricultural Research Council (BARC)	Chairman Farm Gate, Dhaka
4.	Bangladesh Agricultural College	Principal Sher-e-Bangla Nagar, Dhaka
5.	Bangladesh Agricultural Research Institute (BARI)	Director General Joudebpur, Dhaka
6.	Bangladesh Agricultural University	Vice-Chancellor Mymensingh
7.	Bangladesh Cotton Development Board	Executive Director Khaamarbari, Farm Gate, Dhaka
8.	Bangladesh Jute Research Institute (BRRI)	Director General Manik Mia Avenue, Dhaka
9.	Bangladesh Rice Research Institute	Director General Joydebpur, Dhaka
10.	Soil Resources Development Institute	Director Farm Gate, Dhaka
11.	Fisheries Research Institute	Director Chandpur
12.	Fisheries Inspection and Quality Control Laboratory	Deputy Director Khulna

13.	Forest Research Institute	Director Shola Shahar, Chittagong
14.	Livestock Research Institute	Additional Director Mohakhali, Dhaka.
15.	Hydrology Directorate	Chief Engineer (Hydrology) 72, Green Road, Dhaka.
16.	Hydraulic Training Institute	Deputy Director Bhagyokool, Munshiganj.
17.	Institute of Nuclear Agriculture	Director Mymensingh.
18.	Marine Fisheries Research Management and Development Project	Project Director C.G.O. Building, 2, Agrabad, Cox's Bazar.
19.	Marine Biological Research Station	Senior Scientific Officer Cox's Bazar.
20.	National Herbarium	Director 229, Green Road, Dhaka
21.	River Research Institute	Chief Engineer 72, Green Road, Dhaka
22.	Sugarcane Research and Training Institute	Director Ishurdi, Pabna
23.	Soil Research Laboratory	Director Green Road, Dhaka
24.	Tobacco Research Station	Principal Scientific officer Burirhat, Rangpur
	Energy and Communication:	
25.	Bangladesh Atomic Energy Commission (BAEC)	Chairman Gulshan, Dhaka.
26.	Road Research Laboratory	Director Darus Salam, Mirpur, Dhaka.
27.	Health and Education:	
28.	Bangladesh College of Physicians and Surgeons	President Mohakhali, Dhaka.
29.	Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM)	President Shahbagh, Dhaka.
30.	Bangladesh Medical Research Council	Chairman Mohakhali, Dhaka.
31.	Bangladesh Fertility Research Programme	Director Green Road, Dhaka.
32.	Bangladesh university of Engineering and Technology	Vice Chancellor Dhaka.
33.	Fertility Research Center	Director Monammadpur, Dhaka.
34.	Gano Swastho Kendra	Director Savar, Dhaka.
35.	Institute of Cardio-vascular Diseases	Director Savar, Dhaka.
36.	Institute of Public Health Nutrition Dietetics and food Science	Director Sher-e-Bangla Nagar, Dhaka.
37.	Institute of Diseases of Chest	Director

		Mohakhali, Dhaka.
38.	Institute of Nutrition and Food Science	Director Dhaka University Campus, Dhaka.
39.	Institute of Post-Graduate Medicine and Research (IPGMR)	Director Shahbagh, Dhaka.
40.	International Centre for Diarrhoeal Diseases Research, Bangladesh (ICDDR,B)	Director Mohakhali, Dhaka.
41.	Jahangir Nagar University	Vice Chancellor Savar, Dhaka
42.	National Institute of Preventive and Social Medicine (NIPSM)	Director Mohakhali, Dhaka.
43.	National Nutrition Laboratory	Director Mohakhali, Dhaka.
44.	University of Chittagong	Vice Chancellor Chittagong
45.	University of Dhaka	Vice Chancellor Dhaka
46.	University of Rajshahi	Vice Chancellor Rajshahi
	Industries and Commerce:	
47.	Bangladesh Council of Scientific and Industrial Research (BCSIR)	Chairman, Mirpur Road, Dhaka
48.	Bangladesh National Scientific and Technical Documentation Centre (BANSDOC)	Director BCSIR Campus, Dhaka
49.	Bangladesh Sericulture Research and Training Institute	Director, Rajshahi
50.	Bangladesh Tea Research Institute General	Director Srimangal, Sylhet
	General:	
51.	Bangladesh Meteorological Department	Director Agargaon, Dhaka
52.	Bangladesh Space Research and Remote Sensing Organization (SPARRSO)	Chairman Agargaon, Dhaka
53.	Bangladesh Standards Institution	Director Motijheel, Dhaka
54.	Central Training Laboratories	Director Tejgaon, Dhaka
55.	Defence Science Organization	Chief Scientist and Scientific Adviser, Dhaka Cantt., Dhaka
56.	Environment Pollution Control Department	Director Lalmatia, Dhaka
57.	Housing and Building Research Institute	Director Mirpur, Dhaka
58.	Museum of Science and Technology	Director Kakrail, Dhaka
59.	Geological Survey of Bangladesh	Director Kakrail, Dhaka
	Non Government Organizations:	
60.	Bangladesh Academy of Sciences (BAS)	
61.	Bangladesh Association for the Advancement of	

	Science (BAAS)	
62.	Bangladesh Association of Scientists and Scientific Professions (BASSP)	
63.	Biggan Samskriti Parishad	
64.	Bangladesh Chemical Society	
65.	Bangladesh Physical Society	
66.	Bangladesh Botanical Society	
67.	Bangladesh Society of Microbiologists	
68.	Bangladesh Diabetic Association	
69.	Zoological Society of Bangladesh	
70.	Bangladesh National Geographical Association	
71.	Bangladesh Geological Society	
72.	Fisheries Society of Bangladesh	
73.	National Oceanographic and Maritime Institute (NOAMI)	
74.	Society for Conservation of Nature and Environment (SCONE)	
75.	Community Health Research Association	
76.	Bangladesh Photographic Society	
77.	Chattagram Biggan Parishad	

Annex-4

SMIPC in Brief

The Small and Medium Industry Promotion Corporation is a non-profit autonomous organization established by the government in accordance with the Small and Medium Industry Promotion Law for the purpose of implementing various programs for the promotion of the small and medium industry. The programs include financial assistance extension service, training service, information services and so forth. In accordance with the Special Measures Act for the Promotion of Operational Stability and Structural Adjustment of Small and Medium Enterprises enacted in 1989, SMIPC conducts additional programs to promote technology development and computerization in the small and medium industry sector.

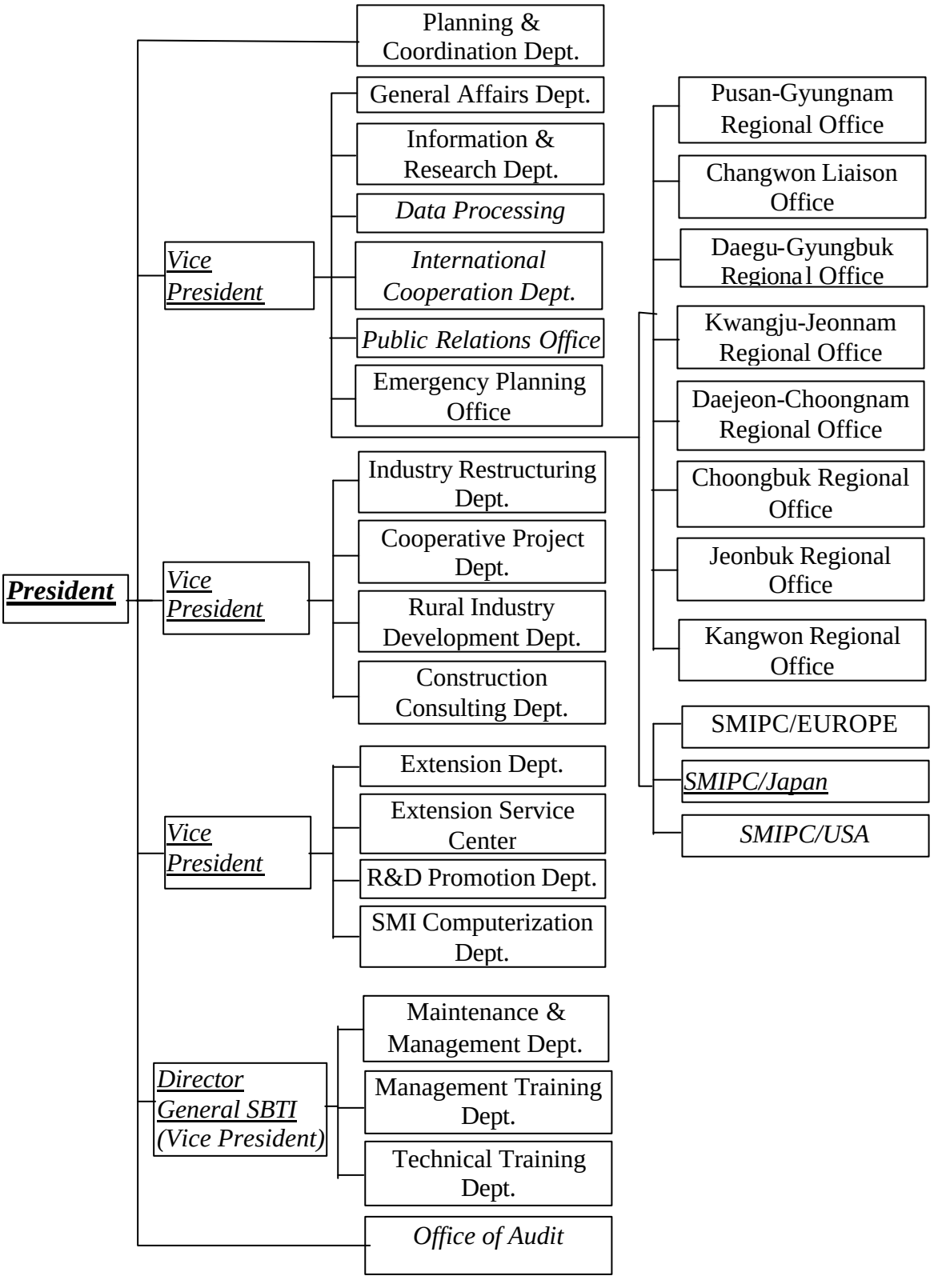
SMIPC derives its financial resources mainly from the Government budgetary sources. The government annually contributes to the Small and Medium Industry Promotion Fund (SMIPF), which SMIPC operates and manages.

Brief History:

December 1978	Small and Medium Industry Promotion Law promulgated
January 1979	SMIPC established
September 1979	SMIPC Europe Office opened
July 1980	Korea Rural Industry Development Center Merged

June 1981	SMIPC Japan Office opened
October 1982	Small Business Training Institute opened
December 1982	Korea Production Technology Corporation Merged
March 1983	SMIPC U.S.A. Office opened
February 1985	SMIPC Regional Offices opened in Pusan-Gyungnam and Kwangju-Jeonnam
March 1987	SMIPC Regional Offices opened in Daegu-Gyungbuk and Daejeon-Choongnam
March 1988	SMIPC Regional Offices opened in Jeonbuk and Choongbuk
March 1989	Special Measures Act for the Promotion of Operational Stability and Structural Adjustment of Small and Medium Enterprises promulgated
July 1990	SMIPC Regional Office opened in Kangwon

Organization



Annex-5

Hi-Tech Vocational Training Centre

Services offered:

Training for individuals & Tailor made courses for corporate sector.
CAD/CAM/CAE Solution
Tooling job work (Mould & Dies)
Automation Project

Training

Facilities:

Facilities	Services
CAD/CAM (UNIGRAPHICS) CNC Trainer with FANUC Control PLC Trainer of GE-FANUC and Modicon Makes Pneumatics and Hydraulics Trainer of FESTO Make. AC and DC Digital Drive trainers of CONTROL TECHNIQUES make. Microprocessor kit of VINYTICS and Micro-controller kit of MOTOROLA make Training modules and equipments of various make	Training in Computer aided design, manufacturing & analysis. Training in operation, programming of CNC and maintenance of system & machines. Training on PLC programming, system installation & diagnostics Training in automation of system using Pneumatics & hydraulics Training in control, installation and tuning of drives for AC & DC motors Training in programming of microprocessors & micro-controllers and Their interfacing Training in Metrology, Control & Instrumentation and Electrical Control Circuits.

AUTOMATION PROJECTS

HTVTC undertakes projects for small and medium industries for developing automatic processes and converting the present machines into automatic machines/SPMS Low ost automation using hydraulic and pneumatic or bigger projects involving complex instrumentation and PLC / Computer are taken up. Prototyping of new products/ controllers / instruments etc. are also taken up for the industries.

CAD-CAM, CNC MACHINING, DIGITIZING AND MATERIAL TESTING

Facilities	Services
CAD/CAM/CAE Unigraphics CNC Machining Centre (MCM) 600 x 600 x 600mm (FANUC-OM) CNC Copy Milling (RAMBAUDI) 1100 X 420 X 3GOMM (FAGOR 8055) CNC Turning Centre (3 Nos.) (∅ 300 x 900mm) FANUC-OT) 3-D Co-ordinate measuring M/c (800 x 450 x 300mm) Grinding: Surface Grinding. (800 x 400 x	Computer Aided Design. Computer Aided Analysis. Computer Aided Manufacturing ie. generation of CNC part programs based on the drawings/components. CNC machining of complex jobs, specially suitable for larger batch sizes. CNC milling: tracing and digitizing of models and machining of parts as per the model. Core and cavity machining based on part model/CNC program specially for machining

200mm), Cylindrical grinding (∅ 300 x 900) Tool grinding machines Universal Testing Machines, Torsion Testing Machine, Hardness Testing Machine, Impact Testing Machine, Ultrasonic crack detector, UV flaw Detector	mirror image of profile is also available. Machining of complex turning jobs. Reverse Engineering: digitization of parts/models etc. Generation of part drawing and CNC part program. Grinding operation on semi-finished parts. Sharpening of cutting tools. Material testing (destructive and Non-destructive).

Some of our esteemed customers are:

Job Work	Training
1. JBM Tools, Faridabad. 2. Evershine Moulds Pvt. Ltd., Noida. 3. Unitech Metals, Gurgaon. 4. The West India Power Equip, Lucknow. 5. Bendy India Pvt. Ltd. Gurgaon. 6. 3D Solutions, Delhi. 7. Axis Tools & Dies, Delhi. 8. Hindustan Office Products, Delhi. 9. Navyug Plastic, Sahibabad. 10. Jainsons & Aircon, Faridabad. 11. Kunstocom Electronics, Noida. 12. T. S. Tech Sun(I) Ltd., Noida 13. Minda Huff Ltd., Noida. 14. Whirlpool of India, Ltd., Faridabad. 15. T: I. Metal Forming, Rewari, 16. P.T.C., Ghaziabad. 17. Hero Global Design Pvt. Ltd., Ghaziabad. 18. Tool Room & Training Centre, New Delhi. 19. Dominant Offset Ltd., Gurgaon. 20. Steel Strips Wheels Ltd., New Delhi.	1. Escorts Faimtrac, Faridabad. 2. Escorts Tractors, Faridabad. 3. Timex, Noida. 4. New Holland Tractors, Noida. 5. Telco, Lucknow. 6. Hindustan Prefab Ltd., New Delhi. 7. Hero Honda, Gurgaon. 8. I.T.C., Saharanpur. 9. Semiconductor Complex, Hyderabad. 10. Central Coal Fields, Bihar. 11. Netaji Subhash Institute of Technology, Delhi. 12. Singareni Colleries, A.P. 13. International Maritime Institute, Greater Noida 14. Baba Atomic Research Centre, Bom-lay 15. Associated Technocrat System House of Siemens 16. Amity School of Engineering. Gurgfton 17. Small Industries Service Institute (SISI) Govt. of India.

Annex-6

List of machinery & equipment for modern workshop foundry and testing

A. Mold and die making, Mechanical shop, Heat treatment and Foundry Machines

1. Electric Discharge Machine (EDM), die sink, with accessories, spares and software.
2. Electric Discharge Machine (EDM), wire cut, with accessories, spares and software.
3. Laser Cutting Machine, with accessories, spares and software.
4. CAD-CAM Desktop tutor, with accessories, spares and software.
5. Three dimensional measurement device with control system and accessories, spares and software.
6. Co-ordinate Measuring Machine with control system and accessories, spares and software.
7. Centre Machine with accessories, cutting tools, spares and software.
8. CNC lathe with accessories, cutting tools, spares and software.
9. CNC milling machine (2 axis control, 3 axis digital readout with DRO, CNC retrofit control) with accessories, spares and software.
10. Three dimensional copy milling machine with accessories and spares.
11. Spiral gear generator with spares and accessories.
12. Pantograph machine with accessories and spares.
13. Surface grinder and Honing machine with accessories and spares.
14. Grinding machine (micro-finish) with accessories and spares.
15. Pressure die casting machine with accessories and spares.
16. TIG/MIG/MAG welding set with accessories and spares.
17. Surface treatment machine with accessories and spares.
18.Heat treatment plant complete with accessories and spares for surface treatment, carburizing, nitriding, annealing and cooling bath/quenching.

B. Mechanical and material Testing Laboratory: equipment /Machinery.

1. Carbon & Sulphur Analyser with Computer and printer
2. Speedy Moisture Tester for moisture determination.
3. Atomic Absorption Spectrometer for estimation of ferrous and nonferrous elements.
4. Pendulum Type Tensile Tester for Bend test and rebend test. Tensile strength determination, compression strength measurement etc.
5. Universal Testing Machine.
6. Magnetic Crack Tester & Demagnatiser for Crack detection.
7. Metallographic Equipment Buffer (Polishing) for surface preparation in metallographic study.
8. Metallographic Microscope with Accessories for study of structure/grain distribution of metals.
9. Metal spectroscope with Accessories for spectroscopic study of metals.
10. Rebound Hardness Tester with Stand cone for Hardness Testmg.
11. Ball impact Hardness Tester for impact testing.
12. Mud contest Tester & core Hardness Tester.
13. Precision Balance Digital, Accuracy: 0 - Ing, weighing range: 200 mg .
14. Computerized Auto scan plasma Spectrometer covering 80 Elements of periodic table.
15. Hand operated Hydraulic pump fitted with calibrated pressure Gauge for measuring compressive strength of ceramics, cement, tiles etc.
16. Ultrasonic crack Detector for internal crack detection

17. Chamber Furnace with Measuring and Regulating panel for Gravimetric Analysis
18. Hardness testing machine Vickers Hardness 60-65
19. Hardness Testing Machine, Micro Vickers
20. Horizontal Testing Machine HT 100 Ton capacity
21. Horizontal Testing Machine 25 Ton Capacity
22. Force Proving Instrument 50 Ton capacity
23. Dead Weight Pressure Tester 0-10 Kg/Cm^2 and 0-700 Kg/Cm^2
24. Portable Hardness Tester Pildisore (500)
25. Hardness Testing Machine, Rockwell 60-65
26. Ultrasonic Flow Detection Machine, Flow detection (10 mm)
27. Hydraulic and Pneumatic Pressure Testing Equipment complete set (Hydraulic 500 Psig, Pneumatic 2000 Psig)

C. Electrical Testing Laboratory: Equipment/Machinery :

1. High voltage power Frequency Test Unit Input 230 V. (AC)
2. Impulse High Voltage Test Unit Input 230 V. AC Output 420 KV (Peak DC) Rated KVA. 10 cont.
3. Storage Type Digital Oscilloscope.
4. Printer
5. Motor Testing Set DC Dynamometer Control Capacity: 500 N-m
6. Dimmer stat (Single phase) oil cool type Input 200 V. AC, output 0.270 V. AC Output Current 200 Amp.
7. Transformer, Input 400 V (AC), Output 5 V, 2500 Amp
8. Insulation Testing Equipment Input 230 V output 3/6/10 KV
9. High Voltage withstand Test Set Oil Cooled type, Input 220V, Output 0-50 KV Capacity 500 KV. 30. 30 Mnt Duty.
10. Electronic Galvanometer Delectation FSD, 0-5 nA, -50 nA, -500 nA -5 uA, -50 uA Micro.
11. Kelvin Double Bridge, 1 ohm (max). Multi Range. 100, 10, 1, 0.1, 0.01, 0.001
12. Laboratory Standard DC Ammeter Moving Coil type full-scale deflection 0-100 mV/150 mV, class (0.2)
13. Laboratory standard DC Volt meter Moving Coil type. Range
0-15v/20v/30v/50v/75v/100vl50v/200v/300v/ class (0.2).
14. Laboratory standard AC Ammeter, Electro-Dynamometer type, Range 0-5A. Class 0.2
15. Laboratory standard AC Voltmeter. Electro-Dynamometer type, Range: 0-150w, Class 0.2
16. Battery charger. Selenium Rectifier type. Input lOOv, Ac output 8V, DC Current capacity 6 A.
17. HV, DC supply unit, Input 220V AC output-1 KV, DC
18. Micro Voltmeter, Range 0-10 microvolt
45/50/100/150/800/1000/1500/2500/5000/microvolt.
19. AC Voltmeter, Moving Iron type Range 0-15 v/300v/600v class 0.5
20. Wheatstone Bridge for resistance measurement, range: 100 ohms (Max), Multiple range : 0.001, 0.01, 0.1, 1.0, 10.100, 1000.
21. Flux Meter, Range : 0.100 wb Multiple range : 1,2,5,10,100,1000.
22. Dial Variable Resistor Range, 1100 ohm (max)
23. Portable Single phase Wattmeter Range Current 2.5 A/5 Amp Voltage 60v/120v/240v
24. Portable power factor meter, Rating : 0.5/1.0/05 lead and lag, Accuracy: ± Degree of phase angle.
25. Multi-range portable AC Amps and Voltmeter, Range: Amp :.3/1.5/7.5/30 A. Volts: 75/150/300v, class 0.5.

26.AC portable Ammeter, Range: 0-5/20/50/100 Amp class 0.5
27. AC portable Ammeter, Range: 0-5/10 Amp class 0.5
28. Portable Mill! Voltmeter (DC), Range: 0-75/100/300 mv.
29. Portable Milli Ammeter (DC). Range: 0-10/30/100/300/ mA class 0.5
30. Portable Milli Ammeter (DC), Range: 0-15 mA Class. 0.5
31. Portable Ammeter (DC), Range: 0-15/50 A Class 0.5
32. Portable Ammeter (DC), Range: 0-25/50 A Class 0.5
33. Portable Voltmeter (DC), Range: 0-15/30v class 0.5
34. Portable Voltmeter (DC), Range: -0150/300v. Class 0.5
35. Portable Voltmeter (DC), Range: 0-1/3V Class 0.5
36. Portable milli Ammeter (AC), Range: 0-20/100 MA, Class 0.5
37. Portable Ammeter (AC), Range: 0-100A, class 0.5
38. Portable Voltmeter (AC), Range: 0-75/150/300 AV Class 0.5
39. Portable Voltmeter (AC), Range: 0-300/600v Class 0.5
40. Portable Voltmeter (AC), Range: 0-30/75v Class 0.5
41. Insulation Tester, Cont. voltage type, volts 500, 100 Mega ohm
42. Insulation Tester, const voltage type volts 1000, 200 Megaohm.
43. Insulation Tester, Range: 1250/2500 V, Mega ohm 200/1000.
44. Earth Tester, Range: 10 ohm
45. Insulation Tester, Range: 1000 V, Megaohms 100.
46. Portable standard Ammeter (DC) Type: Movmg coil, 0 - 250, Accuracy: 0. 5% ohm.
47. Portable standard Voltmeter (DC) Type: Moving coil,: 0 -m 500v,750v, Accuracy: 0.3%.
48. Phase sequence Indicator, Range: 50 - 500 C/S : 100 - 250, 500
49. Air Meter for Air volume measurement to 10 cubic meter.
50. Tong Tester, Range : 0 – 200
51. Portable current transformer, Ratio:
5A/10A/15A/30A/50A/100A/250A/OOA/OOA/50A/1500A.
52. Portable Potential transformer, primary voltage: 110 v, Secondary voltage : 220/440/2200/3300 v.
53. Portable current transformer, ratio 5A: 10A: 15A: 30A: 50A: 100A: 250: 300A: 500A: 750 A: 1500A.
54. Portable Potential transformer, Primary volts: 110v, Secondary volts: 220/440/2200/3300.
55. Standard Resistor, Rating 10000 ohm
56. Standard Resistor, Rating 1000 ohm
57. Standard Resistor, Rating 100 ohm.
58. Standard Resistor, Rating 10 ohm
59. Standard Resistor, Rating 1 ohm
60. Standard Resistor, Rating 0.1 ohm
61. Standard Resistor, Rating 0.001 ohm
62. 3 phase AC Instrument Testing shed with DC generators, DC motors/AC motors/AC
63. Generators with phase shifting arrangements and control panel. Specification (i) 64. Induction Motor 20 HP. RPM 7500, Amps 25-30 (ii) DC Generator voltage 220, Current 40-50 Amps RPM 1450 (iii) DC Motor RPM 1350/1650, Amps 15-20, volts 220 (iv) 3 Phase AC Generator, volts 220, Current 5-6 Amps/2-3 Amps, RPM 1500, Frequency 50 Hz.

D. Electronic Testing Laboratory : Equipment/Machinery:

1. Digital Multimeter: DC voltage Range: 100 mv to 1000 v true RMS. AC Voltage : 100 mv to 750v, Risistance : 100 Mega ohms DC current: 10mA to 3 Amps, True RMS, AC Current: 1.0A to 3.0 Amps.

2. Digital Storage Oscilloscope: Bandwidth : upto 100 MHZ, Maths function : CH1 +00-CH2 Maximum Input 400V (DC+PeakAC) Maximum Sample Rate 20 MS/S Peak Detect 50 ns.

3. Optical Power Meter with sensor: Display : 4 Digit figure, decimal point, polarity units (db, dbm, mw, micro, watt, nw) Range hold, overflow, underflow, Averaging and law Buffer power. Resolution. 0.02 db or less Range selection: Auto or Hold, Measurement mode : Relative level,: Analogue output : 0 to 3 V in each range, Power source : Built-in Ni-Cd.

4. Spectrum Analyser: Frequency Range : 9 KHZ to 1.8 GHZ, Resolution Band width : 30 HZ to 3 MHZ, Amplitude Range : 130 dbm to + 30 dbm, Optimum Dynamic Range: 77 db/90 db, Average noise level: 130 dbm. Relative fmequency : ± 1.0 db. Response : Calibrated Display Range : 70 db, phase noise level-105 db/HZ.

5. Radio Communication Test set: RF Range 400 KHz to 1 GHZ, RF Output: AMi/FM-130 db to 60 db, RF power measurement : 0.01 mw to 150W, Andio Generator : Built in Digital Scope : 0-50 KHZ Auto Frequency : 0.03 to 30 KHZ Measurement: Spectrum Analyser 1.5 to 1000 MHZ Frequency AF Analyser Frequency 0.03 to 6 KHZ Tracking generator : 400 KHZ to 1 GHZ.

6. Mini Optical Time Domain Reflectometer: Wave Length : 1310 nm Distance range : 5 KM, 10 Km, 20 Km, 40 Km, 80 Km, Dynamic range : 23 db Dead Zone (Reflective) less than 10 M. Display : LCD Universal type optical connector detection measurement 18 db, 1C memory card printer interface measurement items (a) break point detection (b) Splice loss measurement (c) Return loss measurement (d) Distance and loss between two points.

7. Auto compute LCR Q-meter: Variable Measurement of R,L,C & Q, Measurement Range : Resistance 0.001 ohms to 1 Meaga ohm; Inductance 0.1 Micro Henry to 9999 Henry; Capacitance 0.1 to 99, Basic Accurancy: (RLC) : + 0.25% Display : 4 Digit.

8. 1.1 GHZ Programmable Signal Generator: Frequency Range : 10 KHZ to 1000 MHZ Resolution 0.1 HZ RF output range : + 13 to- 127 dbm (Iv to 1 mv) Modulation Mode : AM, FM, External source AM mode: 10HZ to 50KHZ, IV peak to Peak Input, External Source FM mode : 50 HZ to 100 KHZ

9. Stabilized light source (LED): Attenuation Level 0.0 to 6.0 db display range: Internal Modulation : Square, Average Frequency Range: ± 0.5%, TTL Output : TT level, duty cycle 50 ± 10% HZ, High optical output : - 3 db, External Modulation 0.3 to 100 KHZ, High stability : 0.02 db (LED unit)

10. Optical variable attenuator: Wave Length : 1-3 Micrometer, Max. Attenuation : 0 to 50 db in 10 db steps. And Infinity, 0 to 15 continuous Variable insertions Loss : 4 db or less Return loss : 22 db or less Applicable Fibre : SM (10/125 micrometer)

11. LED unit: Wave length: 1550 nm, Spectral Half Valve width 250 nm Output wave form : CW light or chopped light 1 KHZ, 2 KHZ Chopped light. Output level - 45 dbm or more Output level Stability : 0.1 db to 0.02db Optical Connector : FC
Applicable Fibre SM 10/125 Micrometers Attenuation level range : Max 6.0 dbs.

ANNEXURE-7

List of Locally Manufactured Light Engineering Products

A. Spare Parts Developed through BSCIC's Subcontracting Programme:

The subcontractors in the LEI sector have developed a total of around 4000 types of spare parts locally. These spare parts belong to Automobile, Rail engine and rail line, Machine tools, Jute & textile, Chemical industry including fertilizer plants, Sugar & food industries, Water transports, Pharmaceutical industry, Gas line fitting, Electrical accessories, Electronic accessories, Agro-support and agro-processing, Telecommunication, Electrical pole fittings, Water distribution line fittings, etc. Apart from these, other LEIs throughout the country produce many other types of spare parts.

B. Complete Machines:

1. **Workshop Machines:** Lathe, Shaper, Drill, Arc welding set, etc.
2. **Food Industry:** Flour Mill, Spice Grinding mill, Oil expeller, Biscuit making machine, Liquid filling machine, Bottle sealing machine, etc.
3. **Agro Processing, Agro Support and Irrigation:** Spryer, Weeder, Power tiller, Hydro-tiller, Foraging, Threshing, Rice mill, Rice boiler, Rice dryer, Low lift pump, Deep tube well, Deep well turbine pump, Low and medium pressure centrifugal pump, Submersible motor pump, Sluice gate, Tea processing machines like, CTC machine (single, duplex, triplex), Rotorvane machine, Barbara leaf conditioner, Green leaf sifter, Britania Type balance sifter, Makintosh sorting machine, Myddleton stalk extractor, Trinic sorter, Slow speed fibre extractor, Tea sorting machine, Rolling table, Trough weathering unit, Miracle mill, Ball breaker, Duplex tea packer, etc.
4. **Pharmaceutical:** Mixer machine, Mixing barrel, Emulsifier, Ball mill, Vacuum emulsifier, Tablet making machine, etc.
5. **Apparels:** Boiler, Washing plant, Washing machine, Dryer, Packing machine, etc.
6. **Jute & textile:** Spinning machine, drying machine, Industrial sewing machine, etc.
7. **Construction Works:** Concrete mixing machine, Soil testing machine, Brick & stone crushing machine, etc.
8. **Water Transport:** Launch, Steamer, Trawler, Barge, Engine driven local boats, etc.
9. **Road Transport:** Body building of bus and trucks.
10. **Electrical Appliances:** Humidifier & Dehumidifier, Water heater, Ceiling fan, Wires and cables, Power transformer, etc.

Source : Subcontracting cell, BSCIC, Dhaka.

Annex–8

Infrastructure for Modernization and Growth of SSIS: In India

Institution	Centres	Functions
Small Industries Development	Established in 1954 Branches spread all over country	Technology development, energy conservation pollution control ISO 9000 etc. Training, Seminars, plant visits.
Small Industries Service institute (SISIs)	As of 1991, 26 SISIs	Provide assistance in all phases of manufacturing, identify items for manufacturing, provide on to on technologies organize workshops. Have well-equipped workshops and labs offering testing services to SSIs.
Directorate of Industries	6 regional and 30 district level establishment.	Industrial development in states Implementation of SSI prootional schemes.
District Industries Centers (DIC)	Began in 1979, 422 DICs operating in 431 districts (counties)	Provide and arrange a package of assistance for credit guidance, training, marketing.
National Small Industries Corporation (NSIC)	Has 3 prototype development and testing centers in country.	Provide equipment on hire-purchase basis. Has marketing boards to promote marketing. Testing centers also provide advanced technical training.

NISIET (extension training institute)	Established in 1962 by GOI	Training, research and constancy in SSI related fields of development, extension and information for development.
SIDBI (Bank)	Established under special act of Parliament in 1990.33 offices (5 regional and 28 branch offices)	To ensure increased flow of financial assistance to SSIs. Direct assistance and indirect assistance schemes (d.g. refinancing)
Information Bank	under system called National Information System for Science and Technology (NISSAT)	Provide information, particularly with respect to latest development in field of technology.

Source: NSIC, India

Annex-9

Overview of non-thermal technologies[1]

Technology	Benefits	Products released
HPP (UHP) High pressure processing (Ultra high pressure)	• Quality and flavour improvements over thermally processed products. • Equivalent level of food safety to thermal pasteurization. • Improved nutrient retention, resulting in higher nutritional value of products. • Extends shelf life of existing products. • Can create unique 'new' product textures. • Uniform 'cooking' of food, regardless of shape or size. • Use in both pumpable (e.g. fruit juices) and non-Pumpable foods. • Can be used as a continuous process in pumpable Foods, hence may result in greater throughput. • Can be used for in-pack foods in any flexible packaging (including glass), eliminating the requirement for additional aseptic packaging processes. • May be useful for uniform freezing to Improve quality of frozen foods due to the immediate formation (if tiny Ice crystals.	In the USA • Jams • Jellies • Fruit juices • Oysters • Guacamole • Processed meat products • Salsas • Europe • Ham • Fruit preparation • Guacamole • Oysters • Fruit juices In Japan • Jam • Jellies • Fruit yoghurts- high acid • Pressure treated 'ready to eat' rice In the UK • Orange juice
PEF (Pulsed electric field)	• Quality and flavour improvements over thermally processed products. • Equivalent level of food safely to thermal pasteurization. • Improves nutrient retention, results in higher nutritional value of products. • Extends shelf life of existing products. • Most suited to fruit and vegetable juices (lower energy costs). • Suitable for pumpable foods. • Suitable for bulk liquid foods prior to packaging. • Has the potential to be 'lower cost' than HPP when fully developed • Has the potential to reduce energy consumption (in comparison with pasteurization)	No commercial products known to be available
UV light (2	• Quality and favour improvements over	• Apple juice

[1] Source: Marcure, Park, Simons, Bates and Mawson, "Market Opportunities and barriers for non-thermal food processing technologies" Food Science Australia Internal Report.

systems)	thermally processed product. • As an enhancement for existing sanitation processes. • Improves nutrient retention, results in higher nutritional value of products. • Extends shelf life of existing products • Suitable (or clear liquids, i.e. apple ciders, fruit juices • Suitable for some cloudy liquids, e.g. pineapple juices. • Cost of equipment is comparatively lower than other non-thermal processes.	• Vegetable juice • FDA approval received for treatment of clear juices.
Ultrasound	• May amplify the effects of some thermal processes in providing product safety. • Not equivalent to thermal pasteurization. • Potential to reduce/eliminate chemical washes. • Offers some additional horticulture, dairy and meat processing benefits (e.g. for extraction, fermentation, functionality, drying, curing, tenderizing). • Low energy and capital cost. • Environmentally friendly. • Can be multipurpose in a some applications. • Easily retrofitted on existing plant.	Process applied in the food industry in customized applications.

ANNEXURE-10

List Of Locally Manufactured Electronic Products

A. Consumer Items (Assembly based on 100% imported components):

Television, Cassette Recorder, Radio, etc.

B. Components:

Single layer PCB, small transformers, replacement type flyback coils, choke coils, etc.

C. Consumer Items (Assembly based on mixed local and foreign technology):

P.A Amplifier, Voltage Stabilizer, Voltage Protectors, UPS, etc.

D. Electronic Equipments (100% locally developed circuits):

a. Computer and Microprocessor Controlled Equipments:

1. Computerized EMG/EP (Electro-Myogram/Evoked Potential) equipment.
2. Computerized ECG (Electro Cardiogram) on-line monitor.
3. Computerized Spirometer (for lung function measurement)
4. Computerized Thyroid uptake system.
5. Computerized Electric Energy Meter Testing System.
6. Computerized Electronic Scoreboard Display.
7. Computerized system for measurement of area of leather.
8. Computerized system for measuring switching time of UPS and Stabilizer.
9. Computerized Motor speed controller.
10. Computer controlled Voltage Stabilizer.
11. Analogue Interface Cards for computers.
12. Computer controlled Teaching System for Children.
13. Microprocessor training kit.
14. Microprocessor controlled pre-paid energy meter.

g. **Non-Computerized Equipments:** DC Power Supply, Power Supply for Discharge Tube, pH Meter, Temperature controlled ovens, Temperature controller for industrial use, Down-dusk photo-switch for security light, Solar battery charge controller, Inverter, Battery back-up 220V ac power supply systems (Instant power supply, Uninterruptible power supply), Electronic ballast, Light &fan regulator, PA and Hi-Fi amplifier, Emergency light with battery back-up, PABX exchange, Mobile telephone to PABX system, assorted equipment for laboratory, Signal Generator, Electronic trainer board, Musical and nerve stimulator for physiotherapy, Iontophoresis equipment for treatment of excessive sweating of palms and soles, etc,.

Source : Rabbani K.S. (prof.), Electronics Society Journal, 2003.