

## **STRATEGIC FRAMEWORK FOR UPGRADATION OF THE INDUSTRIAL TECHNOLOGY IN PAKISTAN**

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### **ABSTRACT**

*Pakistan being a latecomer needs to pursue its technology upgradation through foreign technology components progressively to build up indigenous technological capability, (production, investment, and innovation capabilities). This would be instrumental in developing the strong assimilation capacity of the country. Therefore, the paper presents a two-pronged strategic framework for the industrial technology upgradation in Pakistan. One prong of the strategic framework implies the import of foreign technology which necessitates the establishment of national technology system for manufacturing. Other prong of the strategic framework implies the indigenous technology development which necessitates the establishment of national innovation system for innovation. The proposed frame work is discussed in three major perspectives. The research will result in deriving maximum benefits from the investment in the imported technology. Further research is focused on formulation of institutional framework for national technology system for manufacturing and national system for innovation that will be followed by recommendations to be made for creating fostering and supportive technology climate (enabling environment) in Pakistani's industries.*

**Key Words:** *Strategic framework, Technology upgradation, Technology gap, Technological capabilities, Technology acquisition.*

### **1) INTRODUCTION**

The global competitive business environment has produced innovative international trade challenges between developing and developed regions. Such challenges can affect corporate strategic directions and change manufacturing and business policies (Gordon and Wiseman, 1995; Sambasivarao and Deshmukh, 1995; Ferdows, 1997). For manufacturing companies in developing countries, like Pakistan, the challenges mean that extra efforts are required to survive in the current rapid growing global competitive environment (Mora- Monge, 2008). Manufacturing is

essential and prerequisite for survival in developing countries under such global competitive conditions. Because if manufacturing is given a vital role beyond the traditional support for marketing, it can play a key part in strengthening a corporate's market position (Wheelwright and Hayes, 1985). The available literature shows a widely documented contribution of design and manufacturing technologies to the overall competitive strengths of companies. (Small and Yasin, 1997a; Wheelwright, 1984; Wheelwright and Hayes, 1985; Monge et al., 2006). However, in decades to come, the use of more advanced design and manufacturing technologies will certainly emerge to be a key source of competitive strength. Although, the advanced design and manufacturing technologies advantages and capabilities are already known, problems regarding the management practice, from the technology planning to its implementation, represent the main obstacles to the effective and efficient use of such technologies (Gouvea da Costa and Pinheiro de Lima, 2009). The outstanding industrial achievements of newly emerging economies such as Taiwan and Korea are underpinned by the ability to master technological competencies. These countries acquired foreign technology from developed countries, during the early phase of technology development, and emerged as developers of their own indigenous technological capabilities. Both Taiwan and Korea have entered rapidly into emerging technology fields, and now achieve first-class levels in fields of up-to-date technology, especially in semiconductors and telecommunications (Rahman, and Bennett, 2009). However, on the other hand, the present status of Pakistan's design and manufacturing sector appears to be bleak, with mostly obsolete technology being employed in its industries.

Moreover, given this obsolete level of technology, complicated parts cannot be produced accurately and this leads to high manufacturing time and cost. As a result, the final product is of an inferior quality and therefore unable to attract even the local consumer. Consequently, Pakistan is rapidly losing its share in the international market - this is obviously a sensitive issue for the government. Although cheap labour was a source of comparative advantage for Pakistan at one time, this factor alone no longer ensures competitiveness in the technologically stagnant manufacturing sector. In short, Pakistan is facing a problem of acute technological obsolescence. Therefore, there is a great need for a strategy for the industrial technology upgradation in Pakistan.

## **2) STRATEGIC FRAMEWORK FOR TWO-PRONGED TECHNOLOGY UPGRADATION**

As depicted from the current status of its manufacturing system, it can be seen that manufacturing in Pakistan is mostly concentrated in resource based and low tech products. On the other hand, most developing countries such as China, India, Brazil, Mexico, Philippines, Malaysia, and Thailand have focused largely on medium and high- tech manufactures and are therefore gaining larger shares of these expanding markets and are subsequently growing faster. Moreover, Pakistan cannot even produce/manufacture resource based and low tech products at the international level, as it imports even these products from abroad. This sorry state of affairs within this sector is largely due to technological obsolescence and a lack of skilled labour. Pakistan therefore requires technology upgradation along a specific technology trajectory (Khattak, 2007).

### **2.1) Technology Trajectory (growth) framework**

Technological trajectory is defined as the evolutionary process of technological growth which is observable across industries. Thus, before we can discuss the two-pronged strategy for technology upgradation, it is necessary to at first identify and understand where Pakistan stands in the technological trajectory framework. It is, therefore, necessary to examine the technology trajectories for both advanced and developing countries - this would present an overall scenario as to where Pakistan lies within this framework, and ultimately what strategies it would need to adopt to ultimately 'jump the curve' and catch up with the developed world.

#### **2.1.1) Technology trajectory in advanced countries**

It includes the three stages shown in Figure 1.

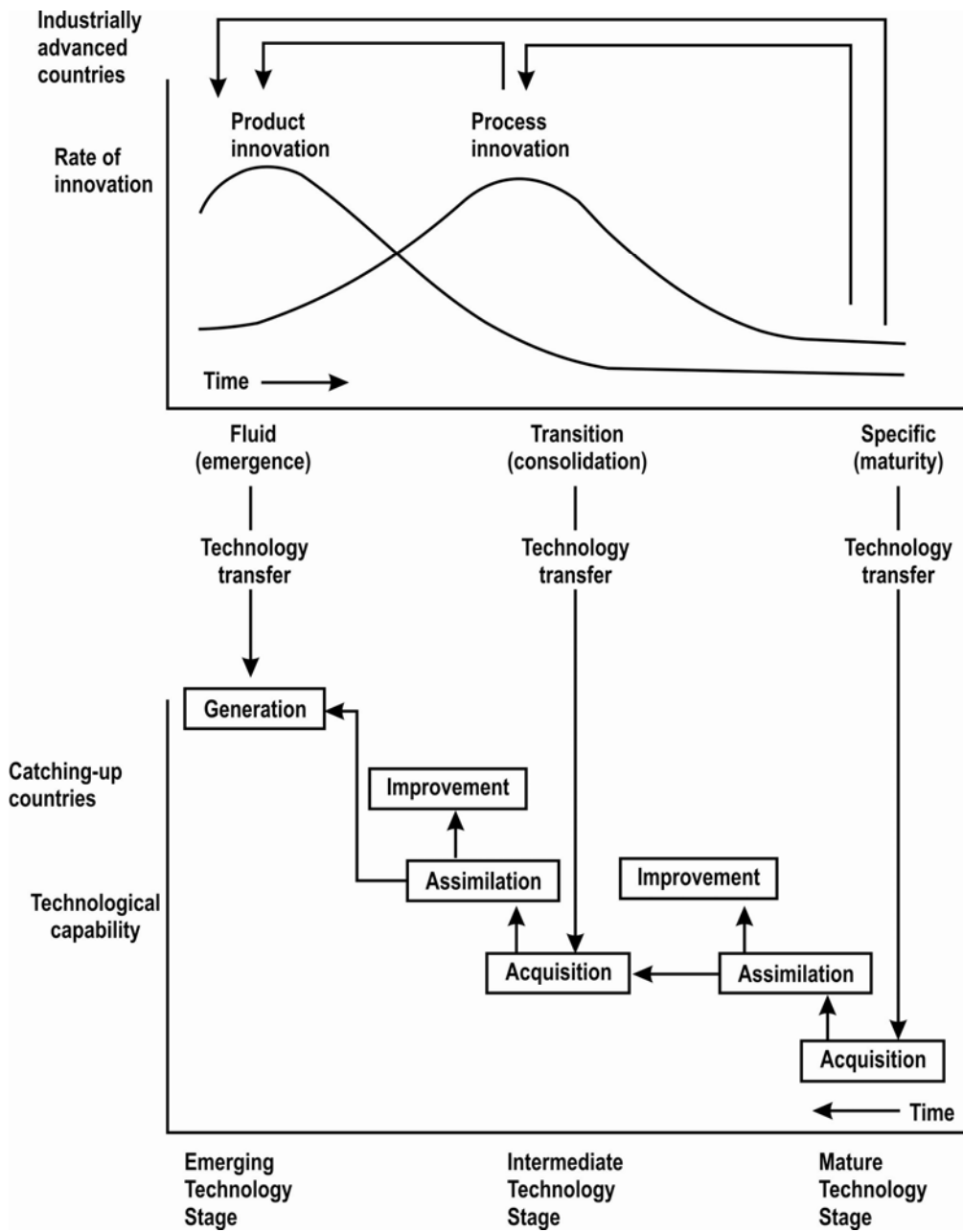


Figure 1: Integration of the two Trajectories

Source: (United Nations, Economic Commission for Africa)

### **2.1.1.1) Fluid stage (emerging technology stage)**

Firms in advanced countries such as Japan typically introduce new technology areas themselves and thus demonstrate a fluid sample of innovation, wherein the rate of drastic innovation is high; the new product design technology is often rough, unreliable and expensive; and product changes with respect to market changes are frequent. Hence, the production systems remain fluid at this stage as organizations need flexible structures in order to respond quickly and effectively to changes in the market and technology.

### **2.1.1.2) Transition stage (intermediate technology stage)**

With time, as the market requirements are better known, alternative product technologies are dropped out of the market, and the transition takes place towards a dominant product design and manufacturing method. This transition towards one particular product thus leads to product performance and competition in price. In addition to the cost competition leads to drastic changes in processes, driving cost down quickly. As a result, operation capability and scale economy now take increased significance.

### **2.1.1.3) Specific stage (mature technology stage)**

With the maturity in market and industry, the manufacturing process becomes more integrated, automated, specific and rigid, and ultimately emerges a highly standardized product. At this maturity stage, the focus of improvements shifts from radical process innovation to incremental innovation in pursuing greater efficiency.

## **2.1.2) Technology trajectory (growth) in developing countries**

It includes the three stages shown in Figure 1.

### **2.1.2.1) Acquisition stage**

Developing countries, on the other hand, first acquire mature technologies from developed countries as they lack the indigenous capability to establish manufacturing operations. Indigenous entrepreneurs thus develop manufacturing processes through the

acquisition of packaged developed technology which includes manufacturing production know-how, assembly operations, product requirements, technical human ware and components. During this stage of the technological trajectory, fairly standard and undifferentiated commodities are produced and thus only engineering capabilities are required at this stage.

### **2.1.2.2) Assimilation stage**

At the assimilation stage, product design and manufacturing technologies are quickly assimilated within the economy - both engineering and development capabilities are required at assimilation stage. This then leads to enhanced competition from new entrepreneurs and eventually drives local technical efforts in the diffusion of imported technologies so as to manufacture differentiated parts and products.

### **2.1.2.3) Improvement stage**

The successful diffusion and assimilation of general manufacturing technology and increased focus on export promotion, along with the enhanced capability of indigenous engineering and scientific personnel, leads to the gradual and step by step improvement of specific (mature technology). Consequently, this stage requires considerable emphasis on engineering, development and research.

### **2.1.3) Integration of the two trajectories**

Once the firms in importing countries have acquired, assimilated and improved upon imported technology, may therefore tends to repeat the up-gradation process with higher stage technologies at the intermediate stage and even at the fluid stage in advanced countries. For example, Taiwan, Korea and China have reached the intermediate stage. Many companies in Korean have accumulated sufficient indigenous technological capability to produce emerging technologies at the emerging stage and challenge firms in the developed countries. The integration of the two technological trajectories is depicted in Figure 1. Japan and Korea's experiences show that both countries initially adopted the developing countries' technological trajectory. The initial stage was to acquire specific (mature) technology from advanced countries- this in turn would help companies develop some manufacturing technology. In

Japan, import of technology and reverse engineering were considered for catching up the initial stage. Thus, during 1950s and 1960s, Japan acquired technology in large quantities in machine tools, automobile and other industries. As a result, up to 1988, Japan became the largest country in the importation of technology. At the subsequent stage, the product design and manufacturing process technology were acquired. In order to bridge the gape up with the developed world, Japan allocated top priority to reverse engineering and in-house R&D in industrial enterprises. Moreover, firms in Japan had a greater propensity for investment in manufacturing processes. At the third stage, firms would engage in R&D work and subsequently acquire the capability to innovate.

## **2.2) Japan's unique pattern of innovation**

Pursuing reverse engineering, firms in Japan produced a unique style of management of innovation combined with reintegrated R&D combined with engineering design, production, procurement and marketing both in medium and large organizations. Further more, entrepreneur in Japan have also introduced a new style of R&D which is closely related to the job of process control and production engineers. Thus, Japan has developed and excellent integration of production management, R&D and marketing. Firms in Japan although tend to make fewer drastic innovations as compared to the American counterparts; they focus instead on mostly incremental innovations in order to improve the product quality and functions.

## **2.3) Paradigm of Korea and Japan catching up model**

Korea and Japan catching up (bridging the gape) model as similar to product cycle theory- capitalizing on being a latecomer. In this regard, Japan first acquired mature technology from the USA (which had already been developed as radical product innovation). Subsequently, Japan introduced various process innovations, based on mature technology and in-house R&D. It is important to note that Japan kept FDI out and focused instead on indigenous R&D, adopting a more inward approach to innovation. Thus in 2001, even Japan invested 4.52% of GDP in the form of Foreign Direct Investment (FDI) outside the Japan, the inward Foreign Direct Investment (FDI) and still remains the lowest in any( OECD) countries, thus representg only 2% of world inward (FDI)flows.

## **2.4) Implications for Pakistan: jump the curve**

Figure 2 indicates that the technology divide between countries has widened noticeably over time. Furthermore, it is important to point out that this technology divide/gap will continue to increase to a greater extent as time progresses, unless technology upgradation is undertaken. A series of 'jumps' to higher levels of the development/time curves is required, by using better generation of technologies to close the gap and reach parity with the developed world (TUSDEC, 2006-07; TUG, 2007). Although Pakistan would initially be an intelligent consumer of international technology, it would ultimately be expected to become a contributor to the international stock of technology. Modernization/upgradation/replacement of obsolete machines is therefore urgently required; this would enable Pakistan to enjoy a competitive edge in the international market and thereby 'jump the curve' (Khattak et al., 2009). Hence initially, Pakistan, like other Newly Industrialized countries (NICs), can follow the acquisition- assimilation- improvement model for its technology trajectory. This would subsequently allow Pakistan to develop its indigenous technological capabilities (ITC), and would thereby enable Pakistan to repeat/reverse the direction of technology growth path (technological trajectory) as practiced in the developed countries (acquisition- assimilation- improvement model); and therefore evolve from the specific (mature) technology stage (duplicative imitation) to the transition(intermediate) technology stage( creative imitation); and subsequently to the Fluid(emerging) technology stage ( innovation). Hence, following the above technology trajectory would enable Pakistan to jump the series of curves and thereby connect to the global value chain. Within a supportive technology climate, the upgradation of technology through the import of foreign technology following acquisition - assimilation - improvement model, injects and facilitates a virtuous cycle in terms of the accumulation of Indigenous Technological Capabilities (ITC). The mechanism behind this virtuous cycle is illustrated as shown in Figure 3. The upgradation of technology through the input of foreign technology injects a demand for greater degrees of sophistication in the existing level of human skills. A surge in the demand in this area then necessitates the establishment of educational and R&D institutions. The provisions of these institutions then create a supply of sophisticated human skills. The next import of technology then be selective and enable the economy to make a correct choice of technology, as well as become self-reliant. Hence, there is a virtuous cycle between technology



upgradation and the accumulation of human skills. The Technology Acquisition Index (TAI) on the other hand indicate that Pakistan's performance on the acquisition of technology is poor as shown in Figure 4. The other indicators such as patents, R&D expenditures, Scientists and Engineers in R&D, Hi-tech exports and Tertiary students in Science & Engineering as evident from Figure 4 on R&D position are poor which lead to poor assimilation and improvement in the imported technology and further in-house generation of cutting edge technology. Thus the pursuit of technology upgradation is imperative for Pakistan so as to connect to Global value chine. However, as observed "Technology development faces a number of market failures, and government need to mount interventions to overcome them and promote technology deepening and diversification" (Lall, 1997; Lall, 2000; Lall and Weiss, 2003). Thus, it is important to realize that given the market failures which exist; the development of such technological capabilities will not occur if left to market itself, and rather requires concerted efforts in the form of a strategic framework based on two- pronged upgradation strategy. The two prongs of the framework are as follows.

**Prong 1:** This prong refers to the rapid induction and assimilation of foreign technology which causes quantum improvement of existing level of technology through the Acquisition-Assimilation-Improvement model.

**Prong 2:** This prong refers to the development of a country's existing technology with indigenous capabilities through the Emergence-Consolidation-Maturity model, which requires the establishment of a national innovation system.

**Supportive technology climate:** This require highly cooperative and facilitating environment which includes supportive management style, supportive organizational environment, and supportive government role.

It therefore, necessitates that the combined strategy of acquisition of foreign technology and development of indigenous technology be pursued for technology upgradation. Thus, Pakistan can manage its technological up-gradation by combining domestic and foreign technology components progressively to build up indigenous technological capability (ITC) (production, investment, and innovative capabilities); that is, the capability to operate and maintain efficient production with imported equipment and to design, manufacture and

improve upon the original equipment independently, This in turn, would be instrumental in developing the strong assimilation capacity of the country, so as to derive maximum benefits from the investment in imported technology. The two pronged technology upgradation strategy will therefore make Pakistan first an intelligent consumer of foreign technology, and eventually a producer of in-house cutting edge technology (under a supportive technology climate). This is illustrated in Figure 5.

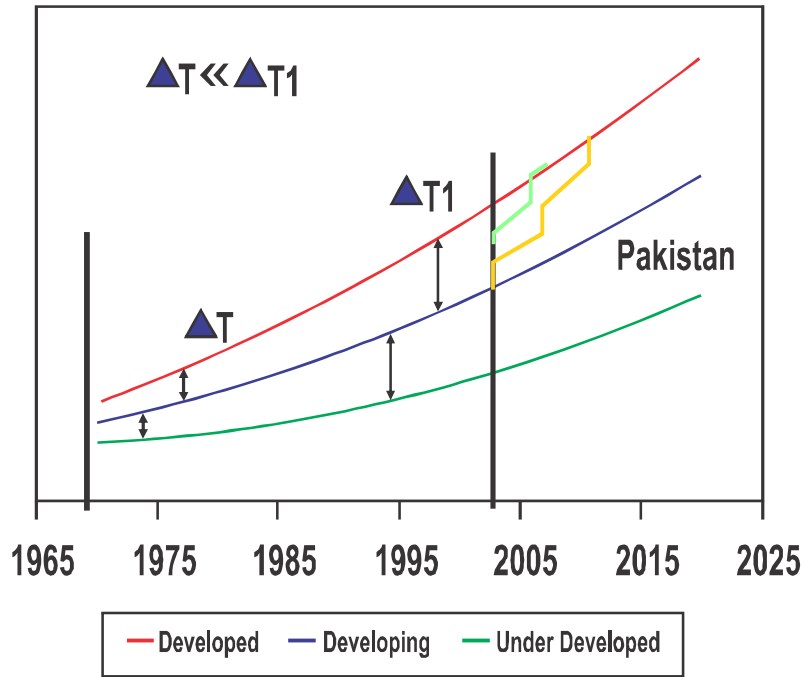


Figure 2: Widening technology gap among nations

Source: M. N. Khattak, *Need for Technology Upgradation Policy JEAS, Dec-2007.*

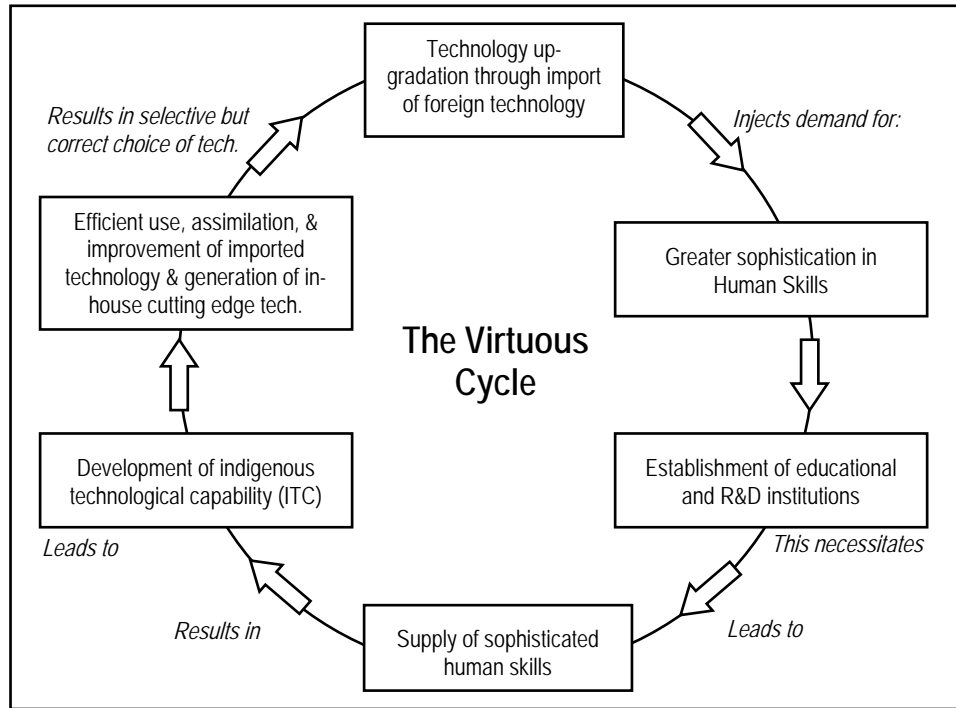


Figure 3: Virtuous cycle in terms of the accumulation of Indigenous Technological Capabilities

Country	HDI Rank	TAI	Parents Granted Per (Milln People)	Royalties & License fee US\$/person	R&D Expnd %of GDP	Scientists/ Engrs in R&D (per million)	Hi tech Exports (% of Manufactured Exports)	Tertiary Students in Science/ Math/ Engg (as % of all Tertiary Students)
Korea	30	0.666	93	14.6	2.7	2319	29	34
Malaysia	58	0.396	-	0.9	0.4	160	57	-
Thailand	74	0.337	-	0.1	0.1	74	31	21
Sri Lanka	99	0.203	0	-	0.2	191	3	29
China	104	0.299	2	0.1	1	545	20	53
Indonesia	112	0.211	0	-	-	130	13	28
India	127	0.201	1	0.1	1.2	157	6	25
Bangladesh	139	NA	-	-	-	51	-	-
Pakistan	144	0.167	-	-	-	69	-	-

Figure 4: Comparison matrix for technology diffusion

Source: Ministry of Industries, Production & Special Initiatives, Government of Pakistan. "Towards a Prosperous Pakistan: A Strategy for Rapid Industrial Growth." January 2005.

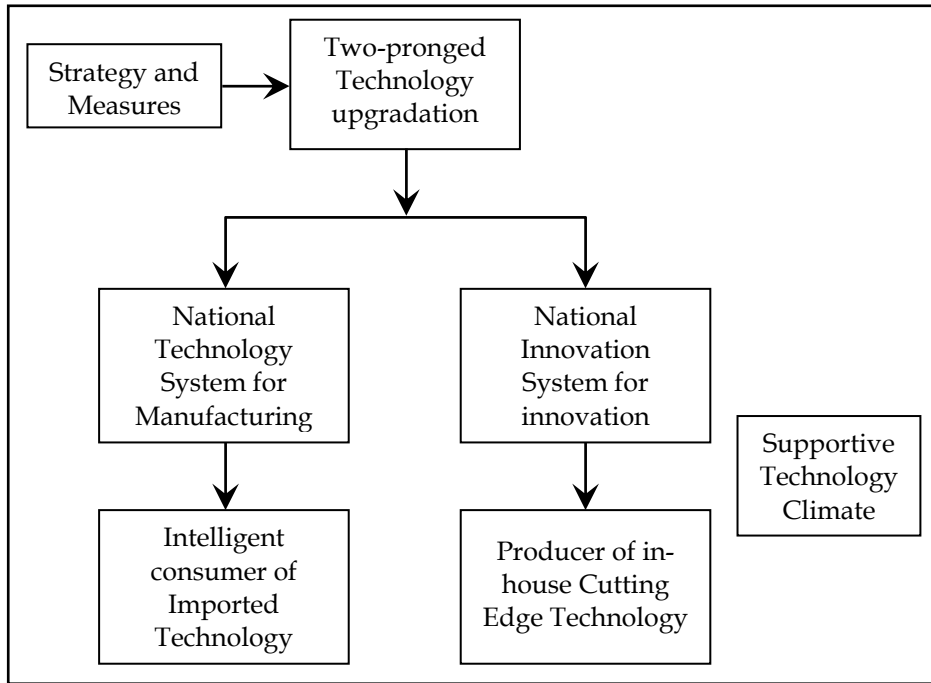


Figure 5: Two-pronged upgradation strategy

## 2.5) Framework for upgradation of industrial technology

This frame work is discussed into three major perspectives and shown in figure 6:-

### 2.5.1) Indigenous technology development perspective:

Since there exist a competitive market, technology development strategies need to be integral part of overall industrial policies, which shape market structures and industrial development.

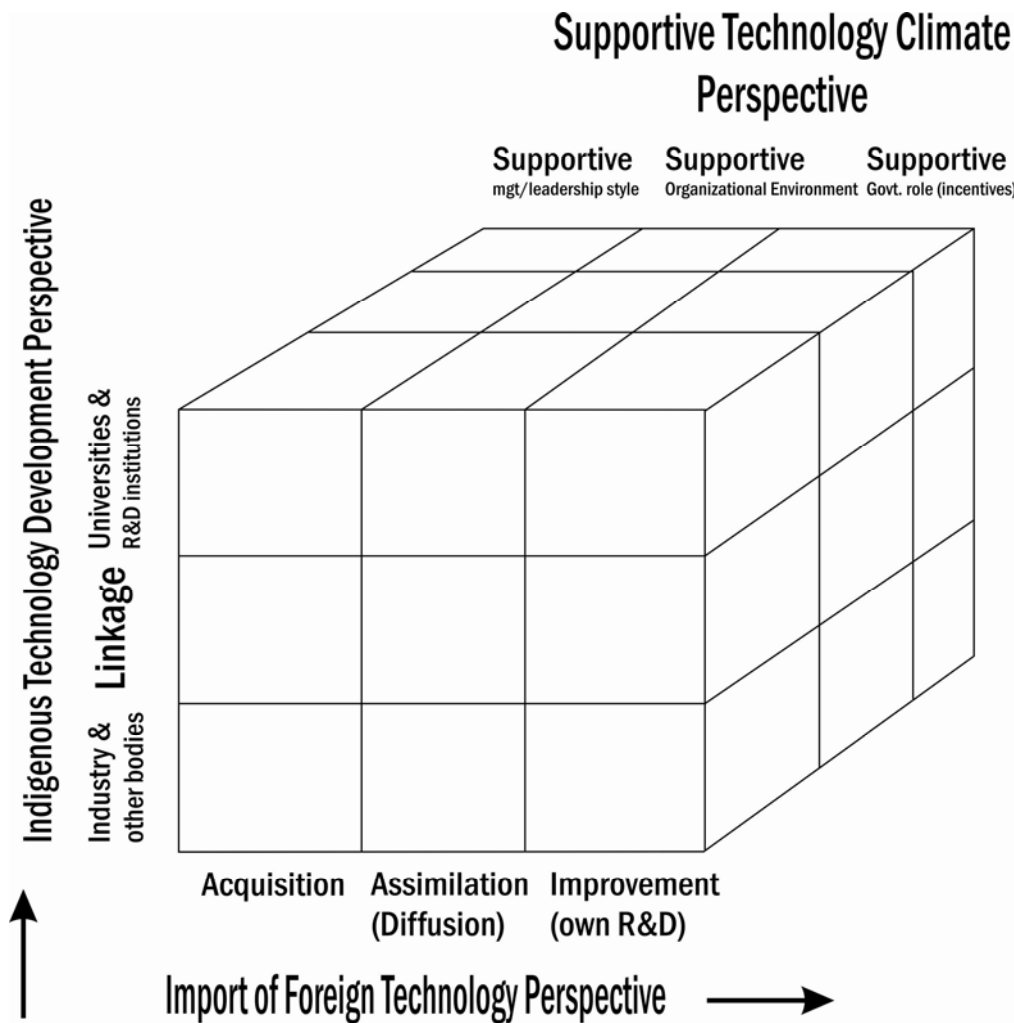


Figure 6: Upgradation framework

**Element 1a: Identification of Existing Status of Technological Status of Industry (low tech ceramics) based on the following indicators**

- 1) Curriculum is aligned with industrial requirements
- 2) Modern machinery for training purposes
- 3) Availability of concerned books in libraries
- 4) Short term courses conducted
- 5) Availability of testing facilities and setup
- 6) Subject are taught related to quality engineering
- 7) Industrial study tour for student are available

- 8) Availability of common facilitation center
- 9) Availability of skilled labor
- 10) Awareness among industrialists from technical and managerial point of view
- 11) Availability of standard raw materials
- 12) Marketing problem
- 13) willingness of labor
- 14) High cost of products
- 15) Obsolete level of technology
- 16) Availability of knowledge and skilled labor
- 17) Know-how by managers and workers
- 18) Quality products
- 19) Existence of R&D

**Element 1b: Identification of Existing Status of Technological Status of Industry (Medium Tech Automobile) based on the following indicators**

- 1) Availability of Designing of Dies, Moulds and Checking fixtures
- 2) Adequate knowledge of process techniques
- 3) Availability of Heat Treatment of Dies/Moulds
- 4) Sufficient CAD/CAM expertise
- 5) Trouble shooting of Machines
- 6) Production Management system
- 7) Functionality of local machinery
- 8) Availability of external source
- 9) Technology Support in production processes
- 10) Process Tool breakage and Machine damage
- 11) High Process change over time
- 12) Difficulty in inventory management
- 13) Frequent Quality Defects
- 14) Availability of skilled manpower
- 15) Availability of raw material
- 16) Labor turnover
- 17) Availability of sophisticated machinery in the local market
- 18) Cost of capital
- 19) Utilization level

**Element 1c: Identification of Existing Status of Technological Status of Industry (High Tech Electronic) based on the following indicators**

- 1) Delays in Testing Services
- 2) Number of Testing facilities
- 3) Limited Range of Testing Services
- 4) Dependence on Personal Contacts
- 5) Support from OEMs
- 6) Accuracy of Results
- 7) High Cost of Testing
- 8) Uniform Geographic Distribution of Testing Facilities
- 9) Local availability of Testing Equipment
- 10) Lack of technology base.
- 11) No Common Facility Centres (CFC) for promotion of modern technologies such as Surface Mount Assembly (SMT)
- 12) Weak supply chain – sourcing systems not established and lack of specifications
- 13) Insufficient R&D capabilities and skilled engineers although universities are producing electrical and electronic engineers
- 14) Lack of quality standards
- 15) Interest of Multinational Companies in this region
- 16) Text issues
- 17) Hi-Tech export (percent of manufacturing export)

**Element 2: Identification of Existing Status of Research and Innovative Capabilities**

Strategy related to enhancing science and technological capabilities through strengthening universities and R&D institutions for the development of Indigenous Technological Capabilities (ITC) is based on the following indicators.

- 1) R&D expenditures as percent of GDP
- 2) Researchers in R&D
- 3) No. of PhD scientists involved in S&T activities
- 4) Percent researchers in Engineering
- 5) Basic research
- 6) Applied research
- 7) Experimental development
- 8) Scientific and Technical Journal articles

- 9) Research collaborations
- 10) Number of Patents filed
- 11) Current focus in R&D in Engineering
- 12) Enrolment in M.Sc & Ph.D

### **Element 3: Identification of Existing Status of Linkages Capabilities**

Strategy related to provide effective linkages between the industry, universities, and R&D institutions is based on the following indicators.

- 1) Researchers/scientists from the industry
- 2) Researchers/Scientists from universities
- 3) Researchers/Scientists from Govt. Research institutes
- 4) Customers
- 5) Vendors and suppliers
- 6) Distributors
- 7) Manufacturers
- 8) Govt. Agencies
- 9) Regulatory bodies
- 10) Joint publications
- 11) Demonstration of research
- 12) Joint patent
- 13) Joint labs at industry and university
- 14) Joint research project
- 15) Internships
- 16) Joint conferences
- 17) Contract research consulting
- 18) Informal meeting
- 19) Technical services
- 20) Consulting services

#### **2.5.2) Import of foreign technology perspective:**

### **Element 4: Identification of Existing Status of Acquisition Capabilities**

Strategy related to acquisition of foreign technology is based on the following indicators.

- 1) High Automation
- 2) High Flexibility



- 3) Good after sales services
- 4) Low maintenance cost
- 5) High performance/efficiency
- 6) Lower Degree of Operating Complexity
- 7) Low Cost
- 8) Selection based on technology gap analysis
- 9) Study/analyse existing level of technology
- 10) Perform technological gap analysis
- 11) Scan international technology shelf
- 12) Proper procedure is followed for identification of technology needs
- 13) No. of industries having selection unit
- 14) Joint ventures
- 15) Licensing
- 16) Reverse Engineering
- 17) Sub contracting
- 18) Corporate R&D
- 19) Others

#### **Element 5: Identification of Existing Status of Assimilation Capabilities**

Strategy related to effective diffusion and assimilation of imported technology is based on the following indicators.

- 1) Arrange seminars/conferences
- 2) Hire foreign expertise for training
- 3) Higher local expertise for training
- 4) Training centre
- 5) Provide on job training to workers
- 6) Installing capability
- 7) Operating capability
- 8) Maintenance capability
- 9) Other capability

#### **Element 6: Identification of Existing Status of Improving Capabilities**

Strategy related to indigenous R&D efforts to improve imported technology is based on the following indicators.

- 1) Basic Innovative Capabilities

- 2) Intermediate Innovative capabilities
- 3) Advanced innovative capabilities
- 4) Self Developed
- 5) Locally Developed
- 6) Acquired from Abroad
- 7) Department of Part/Product Design
- 8) R&D Centers
- 9) Benchmarking

These efforts are crucial to augmenting technology transfer and expediting the acquisition of technological capability. This ability can only be acquired through indigenous technological effort.

### **2.5.3) Supportive technology climate perspective:**

#### **Element 7: Identification of Existing Status of Supportive Management Style**

Strategy related to create supportive management style is based on the following indicators.

- 1) He/she commands respect from everyone
- 2) He/she is a role model for us to follow
- 3) I am ready to trust his/her capacity and judgment to overcome any obstacle that the university is facing
- 4) He/she transmits to us a vision of what the university will be like in the future
- 5) He/she makes everyone around him /her enthusiastic and motivated about work
- 6) He/she encourages us to express our ideas and opinions
- 7) He/she is satisfied when I meet the agreed-upon standard for good work
- 8) He/she makes me feel we can reach our goals without him/her if we have to.
- 9) I earn credit with him /her for doing my job well
- 10) He/she enables me to think about old problems in new ways

### **Element 8: Identification of Existing Status of Supportive Organizational Environment**

Strategy related to create supportive organizational environment within the organization is based on the following indicators.

- 1) People here are given the opportunity to develop a particular product Process/system that has the risk of not working according to specification
- 2) There is a set of University rules and procedures that are followed with regards to the management of R&D activities
- 3) People here are given the opportunity to develop a particular product/process/system that has the possibility of not being commercially viable
- 4) People here generally enjoy working together as a team.
- 5) People here are not allowed to experiment with new ideas that are outside the scope of the research projects.
- 6) Authority is delegated so that people can act on their own.
- 7) When something goes wrong, people here tend to blame one another
- 8) Our organization always stresses the importance of learning from failure and to constantly improve ourselves
- 9) People here are appropriately rewarded for job well done.
- 10) People here believe that their work can have a positive impact on the university's performance
- 11) The interests of customers often get ignored in our decisions.
- 12) government support
- 13) awareness of automotive vendor industry
- 14) sufficient vendor development
- 15) professional business attitude
- 16) Own ability to develop suppliers
- 17) Substandard living conditions of the labor
- 18) Breach of agreements by OEMs

### **Element 9: Identification of Existing Status of Supportive Role of Government**

Strategy related to identify supportive role of government is based on the following indicators.

- 1) Introduce series of incentives to promote exports and use exports as a major mechanism to stimulate its technological learning.
- 2) Pakistan should initially enter into labour-intensive mature technology areas and gradually move towards intermediate technology areas subsequently to Hi Tech. Pakistani firms should initially rely on foreign technology for their technological learning, e.g., FDI and foreign licensing will enable Pakistani firms to acquire. The initial production capability, producing OEM products, OEM production experiences will help firms acquire design capability enabling them to move from OEM to ODM (own design manufacture) stage and to OBM (Own Brand Manufacturing).
- 3) Pakistani firms should intensify, its own R&D to produce high quality engineering products.
- 4) Reverse brain drain can be a major source of innovation capability enabling firms to crack close to the frontier technologies especially in the industrial electronics.
- 5) Pakistan government through direct and indirect intervention should invest heavily in education, especially, higher education to provide competitive human resources to sustain Pakistan's locate for exports.
- 6) Pakistan may introduce adequate public policies and corporate strategies that develop sufficient technological capability to undertake imitative reverse engineering of mature foreign technology products without infringing intellectual property rights.
- 7) Marketing strategies may be introduced so as to introduce market competition in order to expedite technological learning and arrange the technological learning effort.
- 8) The Pakistan government now should use "sticks" in the form of administrative guidance to force firms to reach government goals.
- 9) Rationing of long term bank loans is used as a carrot to draw firms to new paths of exporting, to encourage diversification and to export more. These incentives may be applied to all exporting firms, but they will be more effective, when combined with the greater organizational, financial, political leverage. Exporters may be benefitted through a varieties of tariff exemptions, accelerated depreciations, exemptions from value added taxes and duty free imports of raw materials and spare parts. Tax holydays and reduced rates on public utilities will further boost corporate

- profitability. Assignment of imports licenses may be linked to export performance.
- 10) Lump-sum investment for a production capacity beyond the local market size will bring about economy of scale that will force Pakistan's producers to acquire technological capability, so as to maximize their capacity utilizations.
  - 11) In the force of strong international competition as soon as they enter the global export market, they will be forced to invest heavily in technological efforts, mainly in learning by doing, and reverse engineering, so as to become competitive in both quality and price.
  - 12) Informal technical assistance of foreign OEM buyers to ensure Pakistan made products meeting technical specifications provided is valuable help to Pakistani firms to acquire necessary capability.
  - 13) Firms may be granted unrestricted and tariff free import of intermediate inputs. Firms may also be granted automatic access to bank loans for all export activities even when the domestic money supply is being tightened.
  - 14) Competitive availability of fundamental industrial impacts (labour, raw material, and knowledge and skill infrastructure).
  - 15) Retention of skill and knowledge worker.
  - 16) Repatriation of high qualified technical people.
  - 17) Establishment of high quality testing laboratory to ensure high quality products.
  - 18) Establishment of engineering institutes and Mechanical Training Centers.
  - 19) Provision of subsidies, soft industrial loan, duty free imports of raw material.
  - 20) Development of information database.
  - 21) Attracting FDI in industrial investment.
  - 22) Establishment of common facilities centers.
  - 23) Establishment of R&D centers through government firm joint partnership.
  - 24) Provision of tax incentives.
  - 25) R&D Research & Development matching grants and tax incentives.
  - 26) Technology Acquisition fund (TAF).
  - 27) Productive asset investment incentives.
  - 28) Non tariff policy initiatives.
  - 29) Availability of government support in terms of subsidies.
  - 30) Availability of industrial loans.

- 31) Energy crises
- 32) Tax issues
- 33) Policy issues

### **3) CONCLUSIONS**

The current status of Pakistan's manufacturing sector appears to be bleak, with mostly obsolete technology being employed in its industries. The Technology Acquisition Index indicates that Pakistan's performance on the acquisition of technology is poor. Therefore, the pursuit of technology upgradation is imperative for Pakistan so as to connect to global value chain. It is important to realize that the development of such technological capabilities will not occur if left to market itself, and rather requires concerted efforts in the form of a strategic framework based on two-pronged upgradation strategy. The framework necessitates that the combined strategy of acquisition of foreign technology and development of indigenous technology be pursued for technology upgradation. Thus, Pakistan can manage its technological upgradation by combining domestic and foreign technology components progressively to build up indigenous technological capability. That is the capability to operate and maintain efficient production with imported equipment and to design, manufacture, and improve upon the original equipment independently. This in turn, would be instrumental in developing the strong assimilation capability of the country, so as to derive maximum benefits from the investment in imported technology. The two-pronged technology upgradation strategy will therefore make Pakistan first an intelligent consumer of foreign technology, and eventually a producer of in-house cutting edge technology.

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