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Technology Management Indicators for Developing Countries

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In an increasingly globalized and interdependent world economy, technology has emerged as the driving force behind the structure of domestic production, advantage in market competition, opportunities for across border trade, and higher standards of living. This vital power, however, resides in the productive enterprises, and is derived from their ability to introduce technological innovation continuously. Enterprises introduce technological innovation through acquisition (technology transfer) or self-generation (technology development) to enhance their market competitiveness. Thus, proper management of technological change, particularly at the productive enterprise level, has become the most important consideration for development. To improve our ability to manage technology, however, we need relevant and measurable indicators for investment decision making. This paper briefly presents the rationale and framework for the establishment of a set of such technology management indicators in the context of developing countries.

An enterprise uses many kinds of resources for producing marketable outputs. These include both natural and human-made resources. Technology, as a human-made resource, is the foremost of all means of transforming available natural resources to desirable products and services. Such a transformation process can be simply viewed as adding technology content to the inputs which, in turn, gives market value to the outputs. One possible way for an enterprise to enhance its competitive edge in the marketplace is by increasing its productivity through additional technology content. Increase in productivity arises from change and, in bringing about this change, technology is a crucial factor. Hence the pursuit of increasing the sophistication of all forms (components) of the technology used for transformation of inputs and accumulation of technological capabilities by enterprises. While technology components enable necessary operations, the technological capability of a firm arises from performing activities over time, acquiring resources from outside, and/or generating resources from within. Acquiring technological competence is progressive in nature, however, and is not a once-and-for-all event but a continuous process. Thus, the prosperity of a nation is the result of an ever-renewed innovation process for successful international competition by its productive enterprises.

At the beginning, a developing country enterprise, catering to the domestic market, is almost exclusively dependent on imported and mature technologies to take advantage of relative abundant endowments of either natural resources or unskilled labor, or both. At this stage, local technological capability is likely to involve principally the effective operation of simple imported technologies. These natural resource or labor intensive industries face difficulties over the years due to either depletion (and degradation) of natural resources or decline in labor productivity. For open market competition, an enterprise needs the capability to acquire better technologies and also the capability to maintain and adapt imported technologies for which highly-skilled and motivated human resources are needed. The transition to international competitiveness requires a greater degree of local capability for improvement of imported technologies. While all firms need not be able to engage in major product and process innovation, they must at least have the capacity to undertake incremental improvements in existing technologies, as competition is based on product differentiation and response to demanding customers. Successful entry into this market requires a large number of scientists and engineers and considerable investment in in-house research and development (R&D). Internationally-competitive enterprises pursue innovations leading to the commercialization of new products and processes. Thus, technology development capability becomes the most important prerequisite for emerging areas—Biotechnology, New Materials, Computer Integrated Manufacturing (CIM) and Information Technology (IT) based products and services, which are becoming the world's most fiercely competitive industries. Some of these emerging technologies, being scale-neutral, flexible and situation independent, are opening up new opportunities for developing countries to apply high-tech, but low-cost, solutions to basic needs-related problems. Without utilizing advanced technologies and blends of the traditional and advanced, the surpluses needed for self-reliant economic growth cannot be generated.

Due to the lack of financial and technical resources, enterprises in developing countries are initially dependent upon imports for sophistication of technology components. For advancement of technological capabilities, they are also very much dependent either on the transnational corporations (TNCs) or the national technological infrastructure and climate. The technological infrastructure and climate can be either a constraint to or a catalyst for achieving the full technological potentials of an enterprise. Furthermore, at present, when environmental concern is high on the global agenda, it is important to incorporate environmentalism (a "pollution prevention" form of mind) in technology management decisions. Even in developing countries, environmentally-sound technological resources can contribute to the wealth of a nation through competitive advantage in international trade. It is the foundation upon which the competitive world market of tomorrow is being built.

In a competitive market, the growth of a firm and the trajectory of its technology are closely interwoven. One can also find a direct link between business strategy and technology life-cycle characteristics. In the introduction phase, the performance requirements for new products and market needs are not well defined, which means the source of innovation is often the users and the business strategy is customer and environment responsiveness. In the growth phase, the basis for competition is on performance and specific features. In the maturity phase, with achieved standardization, the basis for competition shifts from performance to diversification with respect to niche markets. In the decline phase, when a new technology is substituting an older one, the continuation of older but still functional products and processes can give competitive edge to companies with significant brand loyalty due to image or to small enterprises serving the price sensitive market vacated by industry leaders (who adopt new technologies for higher value markets). It is, therefore, necessary to integrate technological restructuring into the overall business strategies of an enterprise for successful competition in the international market.

The above brief introduction suggests that, to manage technology resources properly, it is imperative that we attempt an integrated approach to develop technology assessment procedures which should include considerations of: resource constraints, component sophistication, capability accumulation, support from infrastructure, stimulation by climate, strategic restructuring, and environmental soundness. The need becomes all the more critical under the current pace of rapid technological change. This paper presents a set of technology management indicators, corresponding to the above requirements, specifically in the context of the prevailing deregulation and privatization trend in most developing countries.

TECHNOLOGY RESOURCE CONSTRAINTS

Resources for a productive enterprise refer to all available supplies that can be used as needed. It is possible to categorize these resources into three broad types—natural resource, human resource, and human-made resource. Natural resource availability is widespread throughout the world—air is available everywhere; water in most places; food in many places; minerals in some places. There are many constraints with natural resources—everything is not available everywhere; there is uncertainty regarding supply quantity and quality; inadequate concentration at one place for long-term use; the regeneration cycle is generally very time consuming; etc. Although there are problems in determining true market prices of state-owned natural resources (market mechanisms fail if prices are not realistic), endowments of raw materials reduce a country's imports; natural resources, if saved, can be used later.

Human resource has a dual position: the consumer of natural resource and also the producer of human-made technological resource. As previously mentioned, in the present-day world economy, technology is the most important resource for competitive business. As technology changes through a process of never-ending "substitution of old by new," however, any given technological resource becomes obsolete when someone has produced a better one. Therefore, not only does technology by itself not produce results (it is only a means), it cannot even be saved for later application as it becomes non-competitive. Over the years, the rate at which new technologies are generated throughout the world has grown exponentially. Technological life-cycles have become so short that a leading firm has to be willing to make its own products obsolete to maintain competitive posture.

All enterprises compete for scarce resources in an attempt to ensure a steady supply. Consumption of natural and human-made technology resources is very high in the developed countries. Moreover, as it is not location specific and also as it is our own creation, human-made technology resource enables us to develop wherever and in whatever way we want. But, if an enterprise has to depend heavily on imported resources (natural and technological), its market value addition is significantly vulnerable. We therefore need to assess resource consumption compatibility with available resource endowments. An enterprise must consider the relative proportion of locally-available versus imported resources; otherwise it can become the victim of over-reliance on its suppliers from abroad.

TECHNOLOGY COMPONENT SOPHISTICATION

Technology should be understood thoroughly to be managed properly. Hence, it cannot be treated anymore as just "a thing" or simply "a black box." One possible way to comprehend technology fully is to decompose technologies needed by any productive enterprise into four specific embodiment forms (or components). Commonly identifiable technology components for conversion of inputs to marketable outputs are:

- Object-embodied physical facilities, such as: tools; devices; equipment; machinery; structures—called Technoware—which enhance human physical powers and controls for all necessary transformation operations;
- Person-embodied human abilities, such as: skills; knowledge; expertise; creativity—called Humanware—which contribute to actual utilization of available natural and technological resources for productive purposes;

- Record-embodied documented facts, such as: design parameters; specifications; blue-prints; operation, maintenance and service manuals—called Inforware—which enable quick learning and help time and resource savings; and
- Institution-embodied organizational frameworks, such as: methods; techniques; linkages; networks; practices—called Orgaware—which coordinate all productive activities of the enterprise for achieving purposeful results.

All four components of technology (technoware, humanware, inforware, orgaware) interact dynamically and are required simultaneously for the successful performance of an enterprise. The relative importance of the four components of technology depends, however, on the type of transformation and operational complexity. Also, due to the existence of interactions and trade-offs among the components, similar outputs (in terms of technology content added) can be produced by different combinations. That is why choice of technology is a complex decision problem.

Improvement in the degree of sophistication of the four components of technology gradually enhances the technology content addition potential of an enterprise. Generally, technoware degree of sophistication corresponds to increasing complexity of physical transformation operations; humanware degree of sophistication indicates increasing level of competence; inforware degree of sophistication represents increasing utility of available facts; and increasing orgaware degree of sophistication results in improved overall performance in the marketplace. Thus, these four components of technology provide a dynamically interacting base for transformation of inputs to outputs.

Since technological sophistication is essential for competition, assessing the gap of the four technology components relative to the state-of-the-art can indicate the strength or weakness of an enterprise. Major criteria for assessing technoware position vis-a-vis the state-of-the-art may include: scale of operation, scope of outputs, quality of outputs, and safety or environmental soundness of operation. Criteria for assessing humanware position relative to best practice elsewhere may include: level of general education (knowledge intensity); appropriateness of training and retraining, relevant experience, and motivation of the personnel. Criteria for assessing inforware position may include: relevance (value), timeliness (utility), and reliability of acquired facts. Criteria for assessing orgaware position may include: market performance, organizational effectiveness, and technological capability self-reliance of the enterprise.

TECHNOLOGY CAPABILITY ADVANCEMENT

Availability of all four technology components is a necessary but not a sufficient condition for competition. Technology capability is also essential. Technology capability is often confused with the ability to carry out research and development (R&D) only. While this is important, the most critical aspect is the ability to manage technological change. An enterprise in a developing country may obtain the above-mentioned components of technology in two ways-either by importing (transfer) or developing locally. However, to use imported technology or to develop indigenous technology components, experience in "doing" and "institutional learning" needs to be accumulated which gives rise to different technological capabilities. The technological capabilities of an enterprise can be broadly classified into four types, as follows:

Technology Utilization Capability—which includes: operation, monitoring and maintenance of technology components (technoware, humanware, inforware, orgaware) for transformation activities;

Technology Compilation Capability—which includes: commissioning all required physical facilities, coordinating supply and demand, and mobilization (handling and storage) of all resources;

Technology Acquisition Capability—which includes upgrading all components of technology through: searching, selecting, negotiating and arranging timely procurement; and

Technology Generation Capability—which includes: defining market-driven needs, developing new products and processes, building prototype and scale-up facilities for testing, and arranging venture capital funding for implementation of innovations.

These four types of capabilities can also be looked at from the point of view of two kinds of learning—learning by doing (utilization and compilation) and learning to change (acquisition and generation). Advancement of the utilization capability generally refers to increasing the scale of operation, monitoring and maintenance. It enables gradual progress toward optimal use of all available technology components. Compilation capability advancement refers to increased ability to mobilize all resources for optimum efficiency and economic benefits. It corresponds to increasing the scope of operation for responding to different market niches. Acquisition capability advancement results in greater vitality of the enterprise in undertaking technological change management. It also means a better deal in procurement. Technology generation capability advancement indicates realization of crucial self-reliance and control in the supply of critical technology components for effective international market competition.

With respect to acquisition capability, it may be noted that, internationally, financial and strategic imperatives rather than welfare motives dictate the direction of resource flow. For instance, technoware for production and services (other than the state-of-the-art) can normally be bought on the international market for a price determined by the relative bargaining position of the buyer and the seller. However, high quality humanware generally migrate from localities with poor standards of living (developing countries) to places with superior material and professional standards of living (developed countries). Inforware, that can provide a competitive edge, are not sold on the open market, rather restrictions are imposed on the flow of valuable (strategic and critical) inforware for commercial benefits. Although some advanced technoware can be transferred to maintain competitive edge, technology generation is essential. Moreover, decisions regarding which technology to transfer and which technology to develop require proper understanding of the unique nature (successive substitution) of the technological change process, so as to take advantage of possible leapfrogging. Leapfrogging in the use and production of sophisticated technoware is often possible, if humanware, inforware and orgaware are well developed.

The components of technology and technological capabilities are interrelated in a systematic way and they are self-reinforcing, even though some of the interactions occur over vastly different time frames. Also, there is a definite order in capability advancement—starting with utilization capability up to generation capability. However, for advancement with respect to each capability, it is necessary to achieve an increasing degree of sophistication for technology components relevant to the corresponding capabilities. Advancement in the level of capability accumulation means a better level of synergy as the combined actions of separate components make the total effect greater than the sum of individual effects. Capabilities enable an enterprise to react to and to take advantage of new opportunities in an ever-changing world. Capability enhancement is a process of institutional learning, which results in both increased productivity and economic efficiency of an enterprise.

TECHNOLOGY INFRASTRUCTURE DEVELOPMENT

Since almost all enterprises in developing countries are of small or medium scale, their capability to introduce technological change depends on the support provided by the national technological infrastructure. What can be bought and what can be locally developed depends on the status of this infrastructure, which is supposed to promote technological innovation through strong triangular linkages among: academic institutions engaged in science and technology education and research (Academia), a wide range of science- and technology-related research and development organizations (R&D Units), and the engineering and industrial productive enterprises (Industry). Three major types of technological innovation expected to result from these triangular linkages are: product-process innovation, knowledge-skill innovation, and methods-package innovation. A large number of promotion agents (public and private institutions) are necessary to support any or all of these innovations. The totality of these institutions can be called the "advanced factor creation mechanism" or simply the technological infrastructure. Infrastructure status can be assessed by specifically considering the following:

- The strength of "Triangular Linkages" among three types of institutions—the academia, the R&D units, and the industries. Linkage means elements of the link (institutions) and flow between links. Major criteria for assessing the strength of this innovation triangle may include: presence of all links above the minimum critical level, magnitude of their interactions, and extent of utilization of facilities. The magnitude of interactions may be considered in terms of flow of money, technoware, humanware, inforware and orgaware.
- The continuity of technological "Innovation Chains" which include three prominent development aspects—product-process development, knowledge-skill development, and methods-package development. The major phases of the product-process development chain are: searching, designing, generating, and modifying. Phases of the knowledge-skill development chain are: exposing, training, educating, and upgrading. Phases of the methods-package development chain are: conceiving, formulating, preparing, and evolving. The most important consideration is to ascertain the presence and adequate performance of promotion agents corresponding to each phase of the three development chains.
- The catalytic effect of "Technology Mentors" which are generally of two types—investment promotion board and venture capital institutions; and certification, testing, quality assurance and standardization institutions. These institutions contribute significantly in screening the appropriateness of imported technologies and promoting the commercialization of indigenous technologies. Major criteria for assessing the impact of these institutions could be: extent of equity participation, and direct involvement of these institutions with the local enterprises.
- The supportive role of "Technology Guiders," which are categorized into two broad groups—all those institutions involved with science and technology information services; and other institutions engaged in advisory and consultancy services (including technology transfer boards). These institutions provide the direction as well as the opportunity for self-reliance. Major criteria for assessing their contribution could be: value of service provided; and extent of independence from external (foreign) services.

All institutions need a minimum level of critical mass for satisfactory performance. Therefore, a missing link in the technological innovation process exists not only if one of the promotion agents is missing but also if any of the institutions (or promotion agents) lack this minimum critical mass. Any missing link is a serious weakness to be remedied for successful innovation and self-reliance.

TECHNOLOGY CLIMATE DYNAMISM

The success of an enterprise in achieving technology-based development depends to a large extent on the national technology climate within which the enterprise has to operate. Technology climate refers to: degree of national commitment to and socio-cultural acceptance of technology for development; and effectiveness of national mechanisms for integrating science and technology policy aspects with development planning. Besides government policies, there are other actors—market forces and cultural aspects—which set the rules of the game for any productive enterprise and influence the dynamism of the national technology climate. The status of technological infrastructure is also very much linked with the market condition and government policies. Assessment of the order of dynamism of the national technology climate, which determines the technological potentials of an enterprise, can be made in terms of the following important stimulating factors:

- Intensity of "Competition from Open Market Rivals"—which causes pressure for continuous technological innovation. Some possible measures for assessing the fierceness of competition could be: ratio of export of outputs to total production, difference between the largest and the smallest producer, and number of similar enterprises in the local and international markets. One competitive industry helps to create related industries in a mutually reinforcing process. This process of industry evolution often breeds new competitive industries.
- Nature of "Cooperation from a Related Industry Cluster"—which magnifies and accelerates the process of factor creation. Well-developed clusters of related industries help pooling of private resources for technology factor creation, such as: human resource development, information services, consultancy services, etc. Also clusters provide mobility of skilled manpower. The strength of the cluster may be assessed indirectly by determining: ratio of imported inputs to total inputs consumed, and share of the local cluster market to the world cluster market size.
- Pressure from "Special Preferences of Customers"—which makes technological innovation essential. Whether the customers are price, quality, feature or environment sensitive determines to a large extent the business strategy of an enterprise, which in turn influences efforts in technology components and capability development. One key success factor for innovation is that the enterprise must be located in a place which has a reputation for evaluating and using the outputs in a very demanding way.
- General "Conduciveness of Culture"—which depends on many factors, such as: a knowledge-seeking and future-oriented human resource base, an open reward system that encourages innovation and risk taking, strong leadership and commitment through direct involvement, and interest coordination and consensus building for resources mobilization. The leadership (at every level: firm, industry, nation) should catalyze not only the technological challenges and opportunities of today but also preparedness of the future.

A concentration of rivals, customers and suppliers promotes efficiency and specialization, which also influences the innovation process. The incentives and regulatory regimes affecting economic development have to put pressure on enterprises to enhance their technological capabilities, and thereby to increase productivity and competitiveness. Earlier, laws and rules concerning entry, competition, and restraint of trade were adopted to offset the natural tendency of a mass-production-based system to grow to the largest possible scale. Nowadays, it is necessary to encourage resources accumulation and joint research for the development of pervasive and generic technologies.

TECHNOLOGY STRATEGY RESTRUCTURING

Commonly practiced business strategies, under the free market condition, can be categorized as striving for: price leadership through producer cost minimization, quality leadership through customer value maximization, niche leadership through market segment feature specialization, and image leadership through customer prestige creation. The ramification of technology is implicit and pervasive in each of these business strategies. However, to consider technology aspects explicitly, it is desirable to keep in mind the possible technological strategies for securing competitive advantage. In the context of developing countries, the dynamism of the strategic choices is derived from the route for gradual but determined advancement from price, quality or niche leadership situations to image leadership on the basis of the following technological strategies:

- Technology Extender Strategy—imported and old technology-based small-scale start-up enterprises use this strategy for the low-value local market. Some of the general characteristics are: price and service sensitive market; filling market niches by industry giants/leaders (who shift to emerging areas); utilizing time and production factor cost advantages; price leadership; buy readily available technology components; start with elementary technological capability; no research and development.
- Technology Exploiter Strategy—selective importation of technology mostly through joint ventures by medium-sized firms using this strategy for quality leadership in the medium value market. Some of the general characteristics are: emerging international companies basically using advantages of production factor costs and market differentiation; utilizing standardized technologies; reliance on uniform quality; some efforts for method-package innovation; generally price leadership in medium value market; cost savings by cheap labor and cheap input substitutes; buy available technology components; needs secondary technological capability; should have adequate technological infrastructure support; product design often reflects foreign market needs.
- Technology Follower Strategy—creative imitation based on licensed technology enabling large firms to enter the international market. Some of the general characteristics are: international companies adapting and using advanced technologies for growing regional and global markets; reliance on adaptive research and reverse engineering; emphasis on skill-knowledge innovation; economy of scale; subcontracting approach; emphasis on market promotion; niche and quality leadership; high value market; buy and make technology components; needs advanced technological capability.
- Technology Leader Strategy—introducing self-developed technologies giving rise to temporary monopoly in emerging areas. Some of the general characteristics are: pioneering companies using state-of-the-art technologies for competing in growing global markets; heavy reliance on internal research and development; emphasis on product-process innovation through basic research; niche and image leadership; flexible production system; very high value market; monopolistic segment market; economy of scale as well as economy of scope; demand sophistication accelerates quality improvement; in-house R&D for advanced and specialized technology components; needs superior technological capability; conducive technology climate.

It is apparent that, unless there is a world-class research institution producing state-of-the-art knowledge, it is virtually impossible for a small-scale developing country enterprise to start with a technology leader strategy. The likely path for strategic progression in the developing country context is from technology extender to technology exploiter to technology follower and then to technology leader (in very carefully selected areas of specialization). This step-by-step progression pattern in developing countries does reflect a process of industrial restructuring broadly determined by competitive market forces. There is significant technological implication in such a restructuring process in a developing country. The relative importance of technological capabilities also changes as an enterprise attempts to move from the extender strategy to the leader strategy. For higher stages of technology strategy, advanced levels of technological capabilities are required; and there has to be a certain degree of component sophistication for capability advancement. For example, an extender needs to emphasize mostly utilization capability; an exploiter needs both utilization and compilation capabilities; a follower must have adequate utilization, good compilation, and fair acquisition capabilities; and a leader must have all capabilities at a very high level. Also, it may be noted that the critical role of technology transfer and technology development changes along the technology strategy progression path—initially more emphasis on technology transfer and eventually more emphasis on technological development.

TECHNOLOGY ENVIRONMENT SYMBIOSIS

Attempting technology component sophistication (for strategic progression) through technology transfer also requires careful consideration of environmental soundness. Even in developing countries, in addition to economic and technological considerations, one cannot overlook environmental sustainability considerations. For this, we need to assess the appropriateness of transferred technology. However, technological appropriateness is a complex and dynamic concept, involving value based evaluation on the basis of many factors: economic feasibility, endowment rationality, technological progression, and environmental sustainability. Besides meeting government regulations regarding pollution control and waste disposal, decisions regarding technoware sophistication should include considerations of: replacement of non-renewable resources, reduction in the use of scarce resources, re-using all resources, and, whenever possible, recycling all resources to conserve nature. Technology management for sustainable development requires international technology transactions that are: economically efficient, commercially attractive, and, at the same time, environmentally acceptable.

We now recognize that technology is the most important resource for development. We want to use technology as a strategic variable, knowing very well that the application of any technology may have some side effects (immediate or long term). Risk is inherent in all uses of technology. Moreover, over-use, waste, and inefficiency coexist with resource scarcity. Environmental acceptability needs to be assessed in terms of the impact of the enterprise activities toward air, water, land and atmospheric pollution.

RELATIVE ASSESSMENT AND USEFULNESS

Due to the absence of absolute measures, and as the technological change process is very dynamic, assessments of technological aspects have to be undertaken on a relative basis. Moreover, since markets in most developing countries have a high degree of imperfection, conventional financial indicators do not adequately describe the technological capabilities of a firm or an industry. Therefore, technology assessments, focusing explicitly on measuring the technological strengths and weaknesses (relative to the state-of-the-art or best practice elsewhere), could give valuable insight for management decision making. Since the "technology gap" is generally re-enforcing, deliberate investment is necessary to get out of this trap. It is possible to use a relative scoring method in terms of selected qualitative attributes. A possible set of attributes and potential usefulness of these indicators are as follows:

- Dependence on external resources—Alarming-Disturbing-Tolerable-Reasonable—constraint due to foreign ownership with respect to natural resource, human resource and human-made resource. Assessment of vulnerability and critical dependence on foreign inputs will ensure recognition of supplier power of technology and identify importation constraints in its use as a strategic variable for competitive growth.
- Degree of sophistication of technology components—Low-Medium-High-Top—status of available technoware, humanware, inforware and orgaware in relation to best practice elsewhere. Assessment of relative gap from the state-of-the-art (or best practice) can help in evaluating technological strengths and weaknesses for proper allocation of additional investment funds for achieving increased productivity.
- Level of advancement of technological capability—Elementary-Secondary-Advanced-Superior—position of institutional learning through utilization, compilation, acquisition and generation of technology components. This analysis can also help in identifying current institutional strengths and weaknesses so as to build a solid foundation upon which to develop the ability to manage technological change (both technology transfer and technology development).
- Status of development of technological infrastructure—Poor-Average-Good-Excellent—performance posture related to triangular linkages, innovations chains, mentors and guiders. Adequate attention is necessary to ensure the presence of linkages and minimum critical mass resulting in institutions (promotion agents) achieving both relevance and excellence.
- Order of stimulation produced by technology climate—Negligible-Weak-Moderate-Exceptional—dynamism provided by market competition, industrial cooperation, customer preferences and cultural conduciveness. Recognizing that increased funding for research and development is not enough, the policy regime has to encourage technological innovation by the private sector.
- Prospects of technological restructuring—Bleak-Difficult-Promising-Shining—position of strategic progression considering component, capability, infrastructure and climate conditions. Persistent efforts and step-by-step progression with adequate allocation of resources in highly-selective and high-potential areas is essential for strategic restructuring and competitiveness building.
- Associated environmental risk—Extreme-Large-Some-Little—consequences in terms of the impacts on air, water, land and threat to life. Ensuring proper use of technology as the key resource for sustainable development. The purpose is also to promote the generation and use of environmentally-sound technologies to safeguard the natural environment for future generations.

For each of the technology management indicators mentioned, qualitative assessment is possible if one identifies a situation-specific criteria function (many examples were previously given) for relative scoring between the worst and the best position. Once the individual positions are assigned the attributes (with predefined scores), a simple weighted average can give the overall situation. These measurements can reveal the probable implications for strategic decisions and they may strengthen the exercise of foresight and prudence in identifying proper business strategies along with the technology strategies. Such measurements need the wholehearted commitment of the top management and invariably involve enterprise-specific information perceived to be confidential for release to outside investigators. Hence, these indicators are meant to be used by the enterprises themselves or by investment financing banks.

CONCLUSION

Technology, as a human-made resource, is inextricably linked with the welfare of productive enterprises; it is an instrument for achieving higher productivity and competitive growth in market share. At the national level, it helps greatly in improving the standard of living of a people, and as a vehicle of emancipation and greater democracy. However, at the same time, it has been assailed for causing social disintegration and condemned as the cause of environmental decay. Yet, technology is worshipped as the supreme expression of military, economic and political power. Whatever position we take, management of technology is indispensable for both the survival as well as the prosperity of productive enterprises in developing countries under the current trend of trade liberalization and attempts to attract foreign direct investment. And to manage technology properly we need measurable and effective indicators. This paper presented a set of technology management indicators for developing countries.

Besides the support of the technological infrastructure and the conduciveness of the national technology climate in developing countries, the most important considerations in identifying strategic progression paths require a thorough assessment of the status of available technology components and accumulated technological capabilities of a country's enterprises. Although all four components of technology are necessary for each type of capability, the specific combination and the relative importance among the four components of technology are different. Moreover, the relative importance of technological capabilities also changes as an enterprise attempts to move from the extender strategy to the leader strategy. For an enterprise to develop competitively from the initial (start-up) technology extender stage to technology exploiter (expansion) stage to technology follower (consolidation) stage and then to technology leader (mature) stage, technological capabilities need to be upgraded through institutional learning and progressive addition of sophisticated technology components. Therefore, senior management should take a strategic view of technology—identifying vulnerability in terms of the success of the enterprise in sourcing technology, and focusing improvement efforts on technological capabilities for better quality products at lower cost. The framework presented in this paper can help corporate strategic planners in developing countries to meaningfully integrate technological considerations into their business calculus for joining the global market.

<u>Task</u>

Summary and explain the main Indicators.

What are the indicators that appropriate to the Cambodia situation?