

Appropriate technology in developing countries

Mohammad Bahrami seifabad

Department of Management, Yasuj branch, Islamic Azad University, Yasuj, Iran

E-mail: mohammadbahramiseifabadi@ymail.com

Abstract: Achieving the desired state of development is the main goal of planners and decision makers in any society at local, regional, and national levels. If the goal of a society is to develop, it will not be realized without a transformation, mutation, and fundamental change. Achieving various breakthroughs in technology promises great potential facilities and unexpected hopes to all developing countries. Countries that fail to take advantage of these technologies will be at the risk of being marginalized in the world compared with other countries and their people may stay away from the mainstream of political, economic, and cultural life.

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1. Introduction

Achieving the desired state of development is the main goal of planners and decision makers in any society at local, regional, and national levels. Development is associated with multiple indicators and technology progress is of the basic and effective tools to achieve development. Development and expansion of health, medical, welfare, education, communications, security, and so on facilities will be realized through technology progress. Being content to low levels of technology means to abandon all facilities and services that are currently used worldwide. If the goal of a society is to develop, it will not be realized without a transformation, mutation, and fundamental change. Achieving various breakthroughs in technology promises great potential facilities and unexpected hopes to all developing countries. Countries that fail to take advantage of these technologies will be at the risk of being marginalized in the world compared with other countries and their people may stay away from the mainstream of political, economic, and cultural life. So, it is necessary to eliminate all barriers to individuals and nations to achieve technology and seriously avoid imitations and distortions that undermine the dignity and independence of nations. In terms of technology, most developing countries exhibit a strange mixture of tradition and modernity. Today, a significant percentage of people living in these countries use old and primary technologies in different fields of their life, especially in agriculture (Betz, M. J., McGowan, P., & Wigand, R. T. (Eds.). (1984). A large part of the technologies that are being used in new economies come from industrialized countries. These technologies are not too advanced or specialized in most cases. Such communities are highly vulnerable in relation to the situation of the world economy, and such technological innovations

can cause these countries face with difficult circumstances. The explosion of knowledge in the late 20th century, that is called the Information Age, has had great impacts on technological changes. Entering the 21st century, the industrial revolution has given way to the technological revolution. Globalization and technological developments provide opportunities and challenges to developing countries and the question arises that how these countries can bring the process of integration into global community, change its threats into opportunities, and take advantage of the great treasure of global knowledge. Technology has long been considered as one of the essential elements of production and development and has always changed with the growth of human knowledge, as technology is a strategic factor for the economic development of countries in the current age. Moreover, innovation in technology and effective use of new technologies is one of the main ways to gain power and influence and also getting involved in international competition for developing countries. In the past, the role of technology in the development process had been ignored and developing countries were basically run in a way by developed countries to remain in a static situation, according to attachment theory. Most of research questions on technology in the 1960s and the 1970s were associated with the discussion of appropriate technology, technology transfer, and related problems. After this period, various opinions were raised about the appropriate technologies for developing countries with abundant labor and scarce capital and expertise which can be divided into the following two categories:

- 1- Creating intermediate technologies for rural areas and small-scale industries
- 2- Adoption of advanced technologies in large scale.

1.1. Definition of Technology:

Technology is the most powerful factor for development in a society and its progress is continuous process. Technology is a new phenomenon in the contemporary world which is composed of two main pillars of "hardware" and "software". Hardware is any physical and material tool and software includes working practices or techniques of employing the tools. Many people visualize the technology in awe of machines, tools, devices, or hardware, while no hardware can do works alone. Contribution of human to efficiency power of any conceivable hardware is an indispensable factor. Therefore, technology means all the processes, tools, systems, methods, techniques, and knowledge as hardware and software that help the society to preserve, survive, and promote the life and solve practical problems (Baron, C. (1984). Any technology is divided into various degrees and has a continuous process. Since technology is the main core of development system complex, its changes affect all organs and system components.

Technology components are as follows:

- 1- Technology information
- 2- Research and development
- 3- Design and engineering
- 4- Manufacture of tools and machinery
- 5- Construction of industrial facilities and production units
- 6- Operation and maintenance of industrial facilities and production units
- 7- Storage, transport, handling, distribution, and sale of products

2.1. Appropriate technology:

Before selecting and using any kind of technology, the main concepts of appropriate technology and the process of its better management should be firstly understood and the results should be assessed. Hence, an appropriate and correct selection and design is considered a very critical and yet complicated duty in the process of national development and progress (Ghosh, P. K. (Eds.) (1984). Appropriate technology is any kind of technology that can suggest the most affordable way of using resources, facilities, capital, labor, technical skills of a country and promote the national and social objectives of that country. An appropriate technology should also be more productive than traditional methods, eradicate or minimize unemployment, and create new jobs. This technology should take the maximum use of raw materials and local production tools, save the foreign currency, and take advantage of domestic natural resources. Appropriate technology can help to develop skills in a country and environmentally provides an optimal protection. As raw materials are optimally used in an appropriate technology, it also provides the reuse of

industrial waste. Since developing countries have a limited scientific power and capital in terms of time, natural resources, manpower, and management, they should choose the appropriate technology be considering their talents and potentials and put it in operation innovatively. So, in countries with such limitations, an appropriate technology should be more "user", adapt its products with the market condition and demand, get more use of raw materials, and produce simpler goods according to the income limits of people (Linnell, C. (1995). Selection of an appropriate technology creates more efficient methods and introduces new aspects to human activities. This makes it possible to improve the quality of products, increase efficiency, reduce the time of product promotion, and satisfy the unlimited needs of human. There are always differences between a technology and a high technology that are listed in the following tables.

Table1: The list of differences between a technology and a high technology

Technology	High technology
Efficiency	Effectiveness
Economy of scale	Economic image and attitude
Knowledge of how	Knowledge of why
Data and information	Knowledge and wisdom
Standard - Goal setting	Continuous improvement
Systems and known status	Innovation, invention, and change
Specialization	System approach and integration
Optimization of current systems	Optimal systems design
One process, one method, or better	A process to another method or another process
Hardworking	Smart working

3.1. Major obstacles in the use of an appropriate technology:

Developing countries are always facing with problems in the use of appropriate technology that are considered the main causes of their underdevelopment. Some of these problems are as follows:

- 1- Communication failure and lack of knowledge about appropriate technology
- 2- Lack of suitable incentive systems which can lead to increased demand for products of inappropriate and inconsistent technology
- 3- Imbalance in spending on research and development that its impact can be observed at the global level
- 4- Lack of sufficient fund and discriminatory or inappropriate trade and exchange
- 5- Governance conditions (Lack of understanding of great consequences of technology revolutions by policy makers)
- 6- Insufficient training
- 7- Incompatibility of selected technology with environmental and geographical considerations

4.1. Important points in technology selection:

There are some points in technology selection and application that should be considered seriously and systematically:

1- A software approach toward technology, although it is a time-consuming process and wouldn't yield in a short term. However, it is obviously one of the correct, principled, and scientific options for technology development in developing societies.

In order of importance, manufacturing experience and skills, information and knowledge of production, and organization and management of production are of notable software components in a software approach to technology.

It should be noted that accomplishment of organization and management is subjected to the enough growth of the size and lifetime of production activities.

2- Developing countries need internal research and development, because it is a prerequisite for technology.

In order to realize this, there are some key points that should be taken into account:

- a- Scientific capabilities of researchers
- b- Goals setting
- c- Assessment of obstacles and problems
- d- Determination of tools and methods
- e- Having a thought out plan

It is noteworthy to say that, in the evaluation of research and development, three institutions of government, the private sector, and universities are assessed due to having no profit share.

3- Using the experiences of developed countries, considering political, economic, and social similarities with these countries.

If developing countries want to acquire knowledge and technology without taking advantage of existing knowledge that is the result of the efforts of researchers and scholars and their experiences, it leads to unreasonable waste of manpower, resources, and time in these countries causing irreparable damages.

4- In the selection of an appropriate technology, this basic principle should be noted that technology alone cannot develop a country; if the necessary condition to adopt it is not provided and also it is not complied with the environment is about to be used in, its losses would be more than its benefits.

5- There is no a single and fixed option for all nations to choose an appropriate technology.

6- The ratio of capital and labor must be economically justified.

7- External dependence in the selection of technology should be minimized to the possible minimum.

8- Investment in technology should be in accordance with the economic status of countries.

9- Competition and competitiveness is of the outstanding features of an appropriate technology.

10- Simplification of product and process should be taken into account.

11- Appropriate technology selection must be done in a way to improve the quality of products and easily develop them.

12- In communities where there is a problem of capital and the number of unemployed is high, user technology is necessary to be used.

13- The status of trained manpower or familiar with the technology should be investigated when choosing a technology or there should be program to train required manpower.

14- Appropriate technology must create the most value added for internal supply and resources.

15- Appropriate technology should have the highest correlation with domestic and traditional industries.

16- Required areas of science and research for a technology should exist in a society.

5.1. Technology development:

If it is supposed that growth and equity of developing countries are considered together in one direction, technology should be taken as one of the variables of development strategy. In this strategy, planning authorities will announce their guides to employers of the private sector through central decisions. Economic-political independence of developing countries lies at the development of their domestic science and technology. They have well found that they cannot only rely on developed countries to acquire knowledge and technology and should take advantage of their own capabilities and facilities to develop their technology, achieving economic-social progress, and decrease their dependence on other nations (JONES, G. 1971). Self-reliance in research and development doesn't mean to do again all research done by developed countries, but it means to use the research done in other countries and adapt them with the needs of domestic technology. Technology development is actually innocent of tyranny of mechanical humans any other kind of tyranny and arrogance and mostly pursues productive objectives. Technology development and change trend has two goals; higher performance and satisfying the public needs. Higher performance in technology means higher speed, greater capacity-building, development of cost effectiveness, higher efficiency, increased ability, reduced human efforts, more peace, and more mechanized applications. Technology development is considered as the infrastructure of economic growth. Any change in the economy of developed countries affects the economy of developing countries. Hence, technology development closes countries to each other.

Technology has a direct interaction with other environmental factors. Political, military, social, economic, organization & management, customers, competitors, and the market changes have always had an impact on the process of technology development, while technology development has a huge role in promoting the living standards and economic growth of nations. Knowledge management and outsourcing management in the process of technology absorption and synergy are the main topics of strategic management which create the highest value in the shortest time and provide services tailored to market needs during the technology development process. Technology development route in developing countries is often affected by the basic needs of society and available technologies. This double approach suggests a combinative model composed of market pull and technology push.

6.1. Technology transfer:

The importance of technology transfer and its role in the industrial development of countries and bridging the technological gap between developed and developing countries are not deniable. Developing countries, particularly in East Asia have improved the base and foundation of their technology through its transfer from developed countries and then tried to enhance their academic and research centers by providing a good economic infrastructure (Darrow, K. & Saxenian, M. (1993) .

Technology transfer process can be divided into three major sections:

- 1- Technology selection and acquisition
- 2- Adaptation, application, and absorption of technology
- 3- Technology development and dissemination

Any technology is considered an appropriate technology at its original place and time and also or it can be so at any time in future or in a different place if the environmental factors and its objectives are consistent with its origin. However, the use of imported technology has some limitations such as non-compliance with environmental and geographical conditions and need for heavy investment, professionals with high skills, and a developed infrastructure. Moreover, imported technologies cause the dependence, in terms of raw materials and experts on production and storage, last. The key to overcome these consequences for developing countries (which want to transfer technology) is to expand research and increase attention to the development of science and technology and also modifying these technologies in accordance with society's needs.

Green Revolution which led to self-sufficiency in food and agriculture in developing and populous countries such as India, Pakistan, Indonesia,

the Philippines, etc is a successful example of technology transfer and one of the fruits of adaptation of advanced technologies with environmental conditions of developing countries. Indeed, this success is largely due to the growth in research spending in these countries. Technology imports helps consumer goods to be produced in the first step, and then used to produce intermediate and capital goods, and finally leads to production of new goods (Willoughby, K. W. (1990).

Developing countries, in the course of globalization, should take advantage of appropriate capabilities and capacities to absorb and develop up-to-date technologies and enjoy them to produce new products and provide new services. This is led to creating value when the advantage of technology and, market entry, and sustainability in the global competitive environment are gained. Hence, the main issue of these countries is technology selection based on identified needs of present and future market and how to attract and acquire it. Modern and eminent technologies are usually knowledge-based require a heavy investment and a long time for development, while markets demand fast response, low price, strong support, capability of development, and high flexibility.

Transfer of technology to developing countries is faced with obstacles as listed below:

- 1- Disproportionate political and social structure
- 2- Weakness of the middle class and poor management
- 3- Weaknesses in public literacy
- 4- Population growth and non-use of manpower
- 5- Cultural factors
- 6- Weakness of the education system
- 7- Dependence on developed countries
- 8- Plundering of developing countries by colonial states
- 9- The level of technology in these countries
- 10- Infrastructural factors

7.1. Vulnerabilities and threats in the selection and use of appropriate technology in developing countries:

There are two major vulnerability and threat about selection and development of technology that if they are ignored, they can act as a poison to developing countries and seriously jeopardize the economic life of communities.

1- Giving priority to hardware in the selection of technology and downplaying the software. In other words, using the most advanced machinery is a clumsy notion of appropriate technology. Technology development through the selection, purchase, and use of advanced machinery is the most basic and unprincipled method to develop technology. Hastiness in buying machinery and a lack of detailed

studies on its consequences such as appropriate service, training, maintenance, supply of spare parts, and lack of optimum utilization of machinery and applying them in a level lower than embedded capabilities are obvious and dangerous examples of waste of energy and resources.

2- The use of any mechanical technology for any combination of manufacturing structure is not suitable and acceptable. In case of not being involved in other sectors of economy, application of this new knowledge which is inconsistent with social-economic structure, in addition to creating a variety of hazardous incompatibilities, brings obvious and hidden unemployment and over migration cities and towns and consequently causes inaccessibility to income and increases economic imbalance between different groups and regions in developing countries. Finally, the comments and ideas of two eminent theorists on technology in the world are mentioned here:

Dr. Misra mentions the following three views about technology and its place in developing countries:

1- The first view belongs to those who believe want developing countries to give up research and technical development and import the latest type of technology from developed countries.

2- The second view belongs to those who want a technology consistent with human skills and believe that developing countries should use a technology which that is compatible with their unskilled, illiterate, and impoverished population. Small seems beautiful and large seems ugly to these people and they are interested in simple life, small industries, etc.

3- The third view belongs to those who believe that developing countries should gain advanced technical knowledge and not the most advanced machinery. Using this knowledge, they can produce machinery which suit their own skills and needs.

In summary of these three views, Dr. Misra believes that none of them has understood the realities and urgent needs of developing countries. Developing nations should apply the newest technical knowledge required to exploit their final resources in order to survive. However, in order to enable the majority of poor and uneducated people to participate and have activity in the process of life, imported technologies are necessary to be rehabilitated and upgraded.

In terms of the type of technology in developing countries, the problem is not the selection of new or traditional technology, but we should see that which technology, for which purpose, and at which condition can solve the problems. For example, if the goal is full employment, user technology should be applied, while when we want make a weather satellite, we have no choice to apply

capital-consuming technology and it should not be set aside due to its limited employment (Huesemann, Michael H., and Joyce A. Huesemann (2011). Schumacher's views on technology and its impacts on the development are based on Gandhi's views.

Gandhi believed that mass production cannot help the poor of the world, but production by the masses can help them. In this regard, Schumacher believes that production system by the masses immobilizes all priceless resources that are owned by human beings, that is to say bright minds and skilled hands and equips them with classy tools. Technology of mass production inherently is violent, harmful to the environment, and cause of vulgarity and absurdity of human, while technology of production by the masses, in addition to using the best knowledge and modern industrial experience, approaches decentralization, is compatible with ecology rules, uses the scarce resources of nature very slowly, and make machines to serve humans, instead of reducing the dignity of human as a servant of machines. Schumacher calls this technology as "Intermediate Technology", because it is beyond the primitive technology of bygone epochs and yet much easier, cheaper, and freer than super technology of rich countries. However, it can be called self-help democratic technology or popular technology (Kaplinsky, R. (1990). Schumacher also emphasizes on small technology. Introducing this type of technology, he believes that developing countries should not look for great technologies. Schumacher says, "I have no doubt that a new approach can be given to technology development; a direction that causes technology to approach the real needs of human. Man is small and, therefore, small is beautiful. Seeking great and huge things will have no result except paving the way for demolition of ego.

4. Discussions

It can be inferred from all mentioned before that economic, social, cultural, and political development of any community is affected by many factors. Technology and its growth is one of the indicators of development in a community. Hence, developing countries must enrich themselves in this field. However, every technology cannot be effective. There have been many countries that sought a specific type of technology but not only didn't achieved remarkable progress using the desired technology but also provoked many economic, social, and cultural problems of their society. Such technology has had many negative consequences.

An appropriate technology must concur with scientific thought of society, industrial and scientific knowledge and research, manpower, capital stock, national resources, values and cultures, industrial management, popular participation, vocational and

higher education, and policy making and planning system of society particularly in science and technology. Development of science and technology should be valued more than the adaptation and transfer of technology. Science and technology must be deeply rooted in a society, so scientific and technical education should be begun from elementary schools or even earlier in order to cause children become familiar with the spirit of science and scientific thinking, because imported science and technologies cannot deeply address the urgent needs of people in developing countries.

In order to improve the level of technology in a society, research & development centers, manufacturing and service centers, universities and centers of higher education, and laboratories should be also established.

Manufacturing, economic, and social structure and context should be transformed and the place and position of technology in production should be changed. Hence, planning for economic-social development and technological progress is necessary.

Technology may have a good or bad nature, but what makes it be useful and valuable is technology management and its application.

Technology management is the management of systems that provide suitable substrates for creation, absorption, and development of technology.

Science and technology should be the servant of people, not their master. If technology is considered separate from science, it will have negative consequences. Although technology has brought many problems and issues for human society, these problems and negative consequences can be minimized and the society can be directed towards economic, social, and cultural development by adopting a systematic and rational policy in selection, adaptation, or transfer of technology. Leading science and technology to serve human considering the determinative role of rapid developments of science and technology in providing the causes of human happiness and fulfillment of his dreams from one hand and new issues and unprecedented problems such as loss of natural resources, environmental pollution, nuclear war, etc. raise very important and ambiguous questions.

The question is that how the interaction between human and technology can be led in the next

future to ensure happiness, peace, and good destiny of all humans. Although many tasks of humans are done by machines or other inventions, the necessity of harmony between man, nature, and, machine is mainly due the fact that man is the only creature that can create surprises and wonders. No invention and technology is as wonderful as man. Machines never can replace humans and that's why man, machine, and nature must work in harmony.

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Corresponding Author:

Mohammad Bahrami seifabad

Department of Management, Yasuj branch, Islamic Azad University, Yasuj, Iran

E-mail: mohammadbahramiseifabadi@ymail.com

References

1. Baron, C. (1984). Ghosh, P.K., ed. *Appropriate technology in Third World Development*. Westport, Connecticut: Greenwood Press. p. 117.
2. Betz, M. J., McGowan, P., & Wigand, R. T. (Eds.). (1984). *Appropriate technology: Choices and development*. Durham, NC: Duke University Press.
3. Darrow, K. & Saxenian, M. (1993). *Appropriate technology sourcebook: A guide to practical books for village and small community technology*. Stanford, CA:Volunteers in Asia.
4. Ghosh, P. K. (Eds.) (1984). *Appropriate technology in third world development*. Westport, CT: Greenwood Press.
5. Huesemann, Michael H., and Joyce A. Huesemann (2011). *Technofix: Why Technology Won't Save Us or the Environment*, Chapter 13, "The Design of Environmentally Sustainable and Appropriate Technologies", New Society Publishers, Gabriola Island, British.
6. JONES, G. 1971. The role of science and technology in developing countries. 174 pp.
7. Kaplinsky, R. (1990). *The economies of small: Appropriate technology in a changing world*. London: Intermediate Technology Publications.
8. Linnell, C. (1995). Appropriate technology in the technology education curriculum. *Journal of Industrial Teacher Education*, 32(3), 83-86.
9. Willoughby, K. W. (1990). *Technology choice: A critique of the appropriate technology movement*. Boulder, CO: Westview Press.

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