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Technology Transfer in Developing Countries, Challenges and Strategies: Case Study of Iran's Auto Industry

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Abstract

The aim of this paper is two folds:
1- To compare the level of technological advances in Iran's Automotive Industry with that of its competitors globally.
2- To compare the relative technological advances of Iran's Auto Industry with other sectors of the Iranian economy.
To measure the level of technological advances, we have used the Atlas Model of Technology.
The results indicate that the level of technological advances in Iran's Auto Industry is quite low compared to developed countries; differences in the level of technology used in other sectors of the Iranian economy are not statistically significant.

In conclusion, we proffer several recommendations and suggestions for improving the current level of technology in Iran's Auto Industry.

Keywords: Technology, Auto Industry, Techno-ware, Org-ware, Info-ware, Human-ware, Auto Parts

I- Introduction

Technology used to be known as a *transformer factor* for inputs to outputs, today it comprises the following:

1- Equipment and machinery

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2- Skilled, scientific and creative man-power
3- Comprehensive information system
4- Organizational ability and management

1- Introduction

The efficient interaction of the above factors influences the performance of companies and the national economy as a whole. Manufacturers and their agents can be considered motors for development. The aim of producers and agents is to achieve "*added value*" and competitiveness. In addition, the use of superior materials, efficient production methods and availability of adequate spare parts are major contributory factors to improving competitiveness.

Current statistical analyses indicate that the rise of GNP in the industrialized countries is due entirely to the changes and improvements in technology. In addition, recent studies have shown that development in technology has a significant impact upon indicators of national development such as population, income per capita, employment, productivity, export and competition in international trade,.

Clearly, changes in economic indicators can have a direct influence on social indicators such as social security, life expectancy, access to medical care and running water, mortality rate, literacy rate and income distribution.

In developed countries, the application of modern technology is directly proportional to the needs of consumers and markets, whilst in the underdeveloped countries, engineers and managers are attracted to the latest technology without regard to the appropriateness of such technology to the needs of their consumers. The inevitable consequence of this action is the underutilisation of machinery purchased.

The effective transfer of technology, through selecting and purchasing of machinery, is best achieved in tandem with suitable services, training, maintenance, access to spare parts, marketing, etc. Otherwise, the financial resources, manpower and other production factors would be wasted.

Iran's Auto Industry, which accounts for nearly 17% of the total added value to the economy, is one of the most important and leading industries in Iran. Whilst every endeavour is made to improve productivity, nevertheless further effort is required in order to improve efficiency.

With this brief introduction, we consider changes in global technology and its use in underdeveloped countries, especially its application in Iran's Auto Industry. Furthermore, we consider the external developments affecting this industry and finally we offer a comparative evaluation of its position viz a viz global changes in technology and other industries in Iran.

2- Theoretical Considerations

2-1- Definitions and Description of Technology Transfer (Te Tr)

1-*Te Tr* may be defined as a "transaction" between two countries, by means of a treaty, or a contract between the provider country and the consumer country. As in all commercial transactions, pricing and market conditions play a crucial part.

2- From a legal view point, *Te Tr may* be conceptualised as the transfer or allocation of licence from the originator to the end user.

3- *Te Tr* is the importation of specific technologies from developed countries to under-developed ones, enabling the latter to apply the newly acquired tools to improve existing methods of production.

The process of Te *Tr* is as follows:

1- Choice of Tech.

2- Acquiring of Tech.

3- Adoption of Tech.

4- Absorption of Tech.

5- Application of Tech.

6- Diffusion of Tech.

7- Development of received Tech.

2-3- The Four Basic Elements of Technology

Technology as a *transformer factor* from *input to output*, is composed of four basic elements, Techno-ware, Human-ware, Info-ware and Org-ware

1- Techno-ware:

Techno-ware represents the tangible part of technology i.e. hard-ware. It comprises complex equipment and machinery. Techno-ware is the main action for transforming the input to output. Two other factors should be taken into account, namely:

1-1- In underdeveloped countries more prestige is accorded to techno-ware than the other three factors of technology.

1-2- The tendency among politicians and industrialists, in developing countries, is to give greater attention to techno-ware and in doing so neglect the expansion of the other factors of technology thus hindering the advance of technology.

2-Human-ware

This can be defined as the animate machines of industry. It encompasses skill, knowledge, creativity and motivation. The required level of these attributes varies from industry to industry; suffice to say that without the right level of skill, adequate research, innovation and technical know-how developing countries cannot hope to compete with the more advanced nations.

Developing countries are net importers of technology. They need the kind of human-ware that is capable of utilising such imported technology to full advantage. This being so, adequate provision for training of operatives should be considered as a high priority.

3-Info-ware

Info-ware is the major element of Tech.; it embodies all the technical information necessary for the smooth implementation of machinery obtained.

Naturally producers of "technology" are more protective of info-ware than techno-ware. The main reason being that such information may include references to intellectual property, sensitive data etc. It is up to the recipient country to use the supplied information to best advantage.

4- Org-ware

Org-ware can be defined as the instrument for achieving goals. It comprises such activities as management, resource allocation and marketing. The effective co-ordination of these activities renders the organisation more efficient.

In general, org-ware canalizes skills and know-how of "Human-ware" in order to achieve the best use of men and machine. The interaction of "Tech.-ware" and "Info-ware" on the one hand and the increase in technical development of "Human-ware" should lead to further advances. This makes the

need for adequate data processing pivital if productivity is to increase in line with more absorbtion of information.

The level of economic expansion and scientific progress in any society determines the complexity of org-ware required by that society. In general, though, there are three levels, viz.:

1- Organizations must take full advantage of indigenous and imported resources in order to facilitate for technological activities with the intention of maximizing earning whilst being mindful of costs. However, the more resources are allocated to research and development the greater the progress in home industries thus obviating the need for further imported technology.

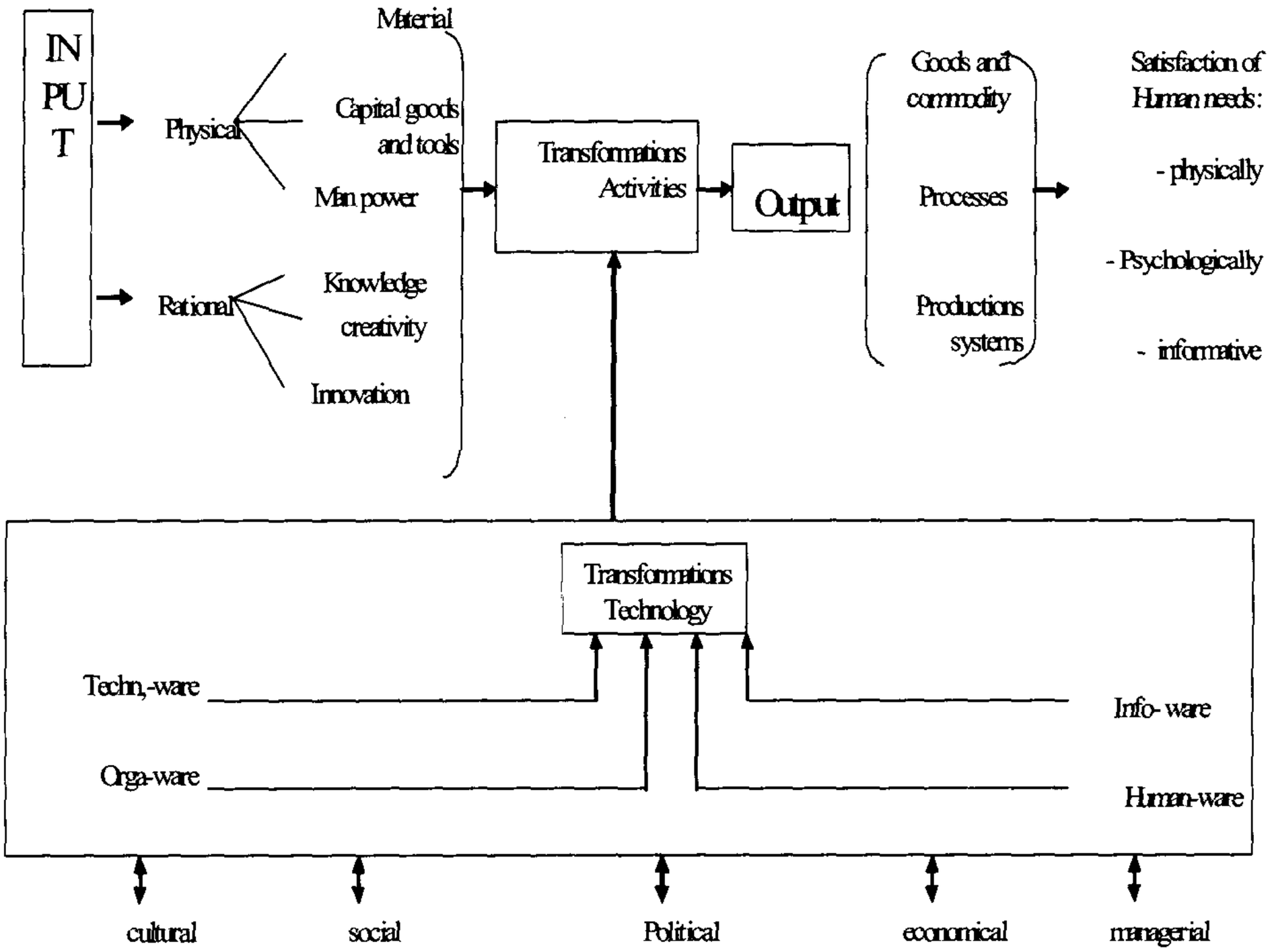
2- In industrialized countries(IC), organizations are often governed by a complex hierarchical team of managers and administrators, whose main function is the directing and channeling of human activities within the organization. It follows, therefore, that effective management can lead to efficient utilisation of resources and technology. Clearly, underdeveloped countries' need for effective management is imperative if their industries wish to reduce reliance upon imported skills.

Current policies and regulations render absorption and interaction of imported Tech. and inland cumbersome industries.

This, in turn, tends to hamper the spread of technology to other indigenous industries.

3- The last form of org-ware is the management system, comprising a set of principles, which impacts upon the attitudes of administrators and managers. (Fig. 1 and tables 1,2,3 and 4).

Fig 1:



SOURCE: Atlas Tech. PP. 25-39

Table 1:The complexity and degree of Techno-ware

Parts of tech.	The level and degree of complexity	Description	Sample
Techno-ware	Hand-made machinery and equipment.	- Attempt and handy control of activities - Combining the mechanical power and physical power, Complete control of activities by the person in charge.	Screw-driver, handmade drill, Elec. Drill,
	Electric machineries owe equipment		
	Common tech machinery and equipment.	-The machine does the main job and contrite up the activities is completely done by the personnel in charge.	Automatic tools drinking factories,
	Professional tech machinery and equipment.	-The machine does the professional job and controlling. -The arthritic is completely done by the personnel in-change (mom-interference)	
	Automatic tech machinery and equipment.	-The machine does a part of the job without the help of human, so the control of job by the personnel in-charge decreases. Personnel in charge should correct the wrong operation of the machine.	
	Computerized machinery and equipment	-Computerized control increases and man-interference becomes less (decreases)	The Factories of producing computerized chips
	Full computerized machinery and equipment.	-The whole activities are done by computer and there is no place for man-interference.	

Source: atlas technology, pp.25-39(Iranian language)

Table 2: The Complexity and degree of Human-Ware

Grad and level	Level	Tech training	Education	Physical attempt	Kind of ability
Half skilled and non-skilled operators and labors	Beginners level and primary school	Mish-School and lower	Very little	Little med, much	ability to work with machine
Skilled operators, labors and technicians	Short course	High school and prof. School	Little	Little and med.	Ability to install
Overhaul technicians specialists and engineers	Short up to med. Period	Prof. School and or University	Med	Little and medium	ability to repair
Producing engineers, (technicians, Specialists and engineers	great (major)	University degree and higher	Much	Little	ability to imitate
Project engineer (technicians, Specialists and engineers)	great (major)	University degree and higher	V. N	Little	ability to accommodate
Improvement engineer (technicians, specialists and engineers)	high	University degree and higher	V. N	V. N	Ability to improve
Developing engineer, (technician, Specialists and engineers	Very high	University degree and higher	V. N	V. N	Ability to renewal

Source: atlas technology, pp.25-39(Iranian language)

Table 3: Grad and level of Info-ware

Te-Element	Grad and level of Complexity	Description	Example
	Orientation of information	Information that helps to know the machinery better.	leaflets brochures, model, pictures
	- Descriptive Information	Information that makes it possible to understand the use of machinery,	technical books
	- Details-Information	Information that helps to choose and install the equipment	Draying of manufacture, Instruction charts and table instruction
	-User Information	Information that makes it possible to have an effective use of machinery and equipment.	full details for setting machinery.
Info-ware	-Comprehensive Information	Information that makes it possible to have knowledge of drawing and operating machinery and also the use of equipment.	process of standardization, quality-control instruction, accounting and cost instruction,
	- Generalization of Information	Information that provides the improving of drawing, process and the use of facilities.	Comparative statistics for technical and economical performance. information That results from internal engineering and R&D
	- Evaluating Information	Information about the position of global knowledge related to machinery and equipment and also the used of that in special goals.	comprehensive Information bout latest changes in construction, improving performance and use of machinery

Source: atlas technology, pp.25-39(Iranian language)

Table 4: The Level and degree of org.-ware

Parts of tech.	The level and degree of complexity	Sample
	Stage of individual communication	family small companies
	Stage of grouping communication	work – shop
	Stage of sectional communication	small industries
Organization ware	Stage of firms communication	Med. industries
	Stage of industrial communication	large industries
	Stage of national communication	multi-purpose industries in different region
	Stage of global communication	international companies

Source: Atlas Tech. PP. 25-39

3-Technological Assessment in Iran's Automotive Industry

3-1- Aspects of external development affecting Iran's Automotive Industry

The rapid advances in automotive technology in the mid 1970s was due to the sudden and dramatic rise in the price of crude oil, instigated by oil producers, on the one hand, and the strong lobbying by the environmentalists on the other.

The increase in the price of oil had a significant impact upon consumer demand and accelerated the pressure from the environmentalist upon governments to enact regulations. Manufacturers were thus forced to consider fuel-efficiency and environmental concerns by producing better engines.

In the eighties the automotive industry underwent a radical change as the shift towards electronic components became more prominent. The development of cataylic converters and electronic injection systems for example led to higher efficiency in fuel consumption and improved emission. Furthermore, attention was given to safety features, hence the development of anti-breaking system (ABS), air bags etc.

The manufacturing of automotive parts and technical know-how is largely the domain of the multinational companies. In essence these "giants" can dictate market conditions and demands. Despite the existence of many small and highly specialised car makers, the multinationals continue to dictate the terms. Inevitably this has had a negative effect upon competition.

The method selected for supplying technology from the producer country to the recipient country, depends upon the political, economical and cultural situation of the recipient country.

3-2-The Level of Tech. in Iran's Automotive Parts Industries

1- General conditions in Iran's Part Manufacturing Industries

Automotive parts manufacturing in Iran, like other industries, faces the same difficulties – insufficient liquidity and inadequate credit facilities. Iran's automotive industry is privately owned, hence its inability to finance its projects competitively. Its diffiticulties are further exacerbated by a weak currency. Lack of foreign investment is another reason; consequently the importing of foreign technology is on the wane

2- Supply of know–how in Car Parts Industry in Iran

The statistical study undertaken by the Auto Parts Manufacturing Society in 200-2002 looked specifically at the ways of imparting supply information to its members. The study revealed that the level of know-how within this sector of the industry left a great deal to be desired. (See tables 5 & 6)

The tables show that in 2000, of the 144 companies; 73 companies obtained the know-how by means of reverse engineering, 32 by purchasing the know-how and 14 companies by purchasing the license. A further 15 by using both reverse engineering and purchasing know-how, 4 companies by reverse engineering and purchasing license, 11 companies by purchasing the know- how and license, and 4 companies by using all the three mechanisms. 52 companies have not used any of the three methods.

In 2001, the Society undertook a similar study of 74 companies (15 of which had been included in 2000 study). The result proved that 20 companies by purchasing the know- how, 51 companies by reverse engineering, 8 companies by purchasing license and 5 companies by using the joint venture obtained better access to production know-how.

A comparative analysis of the figures produced in 2000 & 2002 indicates that little growth had been achieved. The joint venture, however, in 2002 proved to be the most suitable way of transferring Tech. within the industry.

A noticeable aspect of the study is the preference shown for reverse engineering in 2002. The use of know-how purchasing and license purchasing also attracted demand.

3-3-Technology of Automotive Industry in Iran in Comparison to the Global Situation

In this section we focus on eight parts of technology as follow:

1- Existing Tech. in organizing and management
2- Existing Tech. in man-power
3- Existing Tech. in information and technical documents
4- Existing Tech. in machinery and equipment for manufacturing and producing body- parts
5- Existing Tech. in machinery and equipment for body assembly
6- Existing Tech. in machinery and painting equipment
7- Existing Tech. in machinery and equipment for assembling, finishing
8- Existing Tech. in auto testing equipment.

In this study each section is divided into different parameters and the results are shown in separate tables. In order to facilitate the comparison, the global average indicators are shown in front of each parameter. Score 10 is the highest and 1 is the lowest. Table No.3 shows the result of applied technologies in the 8 sections described above in Iran viz a viz the global situation.

Table No. 7 clearly indicates that the level of technology in Iran's automotive industry is far behind that of the developed countries in all the aforementioned sections.

The inertia and malaise, which permeate the means of production, apply equally to management structures in Iran's automotive industry.

3-4- Technological Level in Automotive and Car Parts Industry in comparison to other industries in Iran.

The four elements of technology aside, there are other important factors that need to be taken into account namely, the ability to innovate, to support and supply and the successful application of such abilities.

Information provided in table 8 is self-explanatory and requires no further expatiation.

Table 5: The result of research on Tech. Production Supply in Parts manufacturing industry in the year 2000

Description	Engineering vice-versa (1)	Know-how Purchasing (2)	License Purchasing (3)	(1) and (2)	(1) and (3)	(2) and (3)	(1) and (2) and (3)	Non	Total
The No. of companies	73	32	14	15	4	11	4	52	144
A percentage of total	50.7	22.2	9.2	10.2	2.8	7.6	2.8	36.1	—

Source: Auto and Part Manufacturing Inst. – year 2000 (Iranian language)

Table 6: The result of research a bout tech. Production Supply in parts manufacturing industry in the year 2002

Description	Engine ering vive-versa (1)	Know-how Purcha sing (2)	License Purchasing (3)	Joint invest ment (6)	Other factors (5)	(1) and (2)	(2) and (3)	(2) and (4)	(1) and (3)	(1) and (4)	(3) and (4)	Total
The No. of companies	51	20	8	5	5	6	1	2	4	1	1	74
A Percentage of total	68	27	10	6.8	6.5	8.1	1.35	2.7	5.4	1.35	1.35	

Source: Auto and Part Manufacturing Inst. – year 2002 (Iranian language)

Table 7: Conclusion of Existing technology in automotive industry in comparison with global Situation

Item	Tech. Description	Global Situation	Iran' Situation
1	Existing technology in organizing and management	8.58	1.65
2	Existing technology in man- power	9.14	1.65
3	Existing technology in information and technical documents	10.00	1.46
4	Existing technology in machinery and equipment for manufacturing and producing body-parts	7.46	2.15
5	Existing technology in machinery and equipments for assembling the auto-body	8.00	2.39
6	Existing technology in assembling machinery, decorating mechanic and the last phase	7.00	2.79
7	Existing technology in auto testing equipment	7.56	4.11

Source: Common tech. Evaluation of automotive industry in Iran-Ministry of industries & Mines-2000(Iranian language)

Table 8: Indies of technological abilities and Tech. elements in Parts Manufacturing Industry in comparison with other industries

Item		Ability indices				Parts c.f tech.			
	Industry	Innovation	support	Supply	Application	Hard-ware	Human-ware	Info-ware	Org-war
1	* Blacksmith's	2.6	2.6	2.7	2.7	0.45	0.57	0.49	0.33
2	* Iron foundry	2.9	2.9	2.9	2.7	0.50	0.52	0.49	0.35
3	* Engine/drive	3.1	2.5	2.6	2.7	0.50	0.57	0.55	0.39
4	*Manufacturing industrial equipment	3.3	3.2	2.9	3.4	0.57	0.59	0.55	0.53
5	* Tire	2.9	3.1	3.2	2.9	0.60	0.69	0.59	0.55
6	* Engine oil	2.9	2.8	3.0	3.9	0.57	0.59	0.55	0.51
7	Automobile	2.8	2.8	2.7	2.9	0.53	0.61	0.54	0.50
8	Transformers & boilers	2.1	2.5	2.2	2.5	0.51	0.56	0.52	0.38
9	Metal constructions	2.2	2.6	2.3	2.5	0.45	0.56	0.42	0.28
10	Roller	2.5	2.8	2.8	2.9	0.49	0.56	0.44	0.37
11	Metal forming	2.9	2.9	2.9	2.8	0.47	0.56	0.43	0.36
12	Telephone center	3.2	3.2	3.2	3.3	0.59	0.58	0.57	0.61
13	Flour	2.5	4.0	3.4	3.5	0.69	0.73	0.72	0.55
14	Eating oil	2.6	3.1	3.0	3.2	0.55	0.59	0.51	0.49
15	Cement	2.6	2.7	2.9	3.2	0.60	0.58	0.63	0.54
16	Sugar	2.5	2.9	2.7	3.4	0.51	0.57	0.50	0.34
17	Lamp	2.4	2.8	2.7	3.0	0.65	0.73	0.62	0.43
18	Glass	3.5	3.3	3.2	3.4	0.59	0.61	0.52	0.55
19	Elect. table	2.8	3.1	3.0	2.8	0.55	0.62	0.57	0.48
20	Tile	2.2	2.9	2.7	2.8	0.56	0.58	0.52	0.48
21	Weaving	2.2	2.7	2.6	2.8	0.57	0.64	0.56	0.45
22	Paper	2.3	3.0	2.5	3.1	0.59	0.56	0.49	0.5
	Average of above industries	2.7	2.9	2.8	3.0	0.55	0.60	0.53	0.5

Source: Estimation of technology level in Iran industries, a collection of articles and essays introduced in a seminar of technology and renewal of industry. (in Persian language. Tehran 1378)
*Auto parts manufacturing.

4- Implications and Recommendations

"Tech. is a hobby for the prosperous, a dream for the poor and a key in the wise man's hand."

It is an axiomatic fact that if under-developed countries, Iran included, fail to grasp the advantages of modern technology they can have no hope of competing successfully in the international arena. The embracing of technology inevitably leads to a healthier and more sustainable economy. It is incumbent upon the governments of developing countries to encourage entrepreneurs and industrialists to embrace new technologies with open arms and provide the conditions for such technologies to flourish.

Ennst D. and O'Connor (Atul wad, P.81) in their research into the newly industrialized countries hoping to join the rank of the already industrialised nations have to implement the following policies for science and Tech.

1- Acquiring Tech. and planning strategies to access the Tech. through:

1-1- diversification of resources to provide Tech.

1-2- strategies for the allocation of available resources

1-3- effective utilisation of capital employed

1-4- militating against forces restricting access to new Tech.

2- Diffusion and creation of Tech. through

2-1-increasing effective demands through paving the way for governmental purchasing

2-2- providing information

2-3- creation of skills for optimal application of new Tech.

2-4- satisfying the financial and technical needs of small and medium sized companies

2-5- Creation of appropriate conditions for macro- economy

2-6- Increasing production capacity and intensifying the process of atomisation.

3- Industrial Development through

3-1-policies designed to eradicate traditional protectionism in old noncompetitive industries.

3-2-balancing decentralization and specialization on the one hand and the rigid chain of hierarchy and network of salesman on the other.

4- Revision of structure relation to trade and investment through:

4-1-avoiding the early liberalization of trade

4-2-decentralization in export markets

4-3-creation of bilateral market policies, which increase the regional solidarity and cooperation.

4-4- revision in the policies of the foreign investment.

5- Revision in the Role of the State

The state has a crucial role to play as a catalyst in the spread and expansion of technology and the best use of human resources.

The majority of underdeveloped countries, having unshackled themselves from the yoke of colonial powers, have, for too long, grappled with different ideologies to their cost. Energies that should have been channeled towards creating market economies, often wasted on deciding how people should be ruled. Thankfully the trend is to favour more open societies. However, this does not mean that state interference in developing countries has ended, far from it. Nevertheless, it is important to distinguish between the necessity of state intervention, from time to time, and the degree of limitations imposed upon market forces.

The inherent difficulties referred to above, are no different in the case of Iran. A major research project into strategies for industrial expansion, undertaken by Dr. M. Nilly emphasised the following:

"The biggest problem dogging industry in Iran is the lack of competition. This issue is very important, because a production unit uses machinery, material and labour which create costs. The finished goods are traded in the market place to generate profit, which in turn absorbs these costs. It follows, therefore, that the higher the profit margin the greater the opportunity for expansion; lack of competition hampers this progress.

The main goal of manufacturing industry is the provision of goods & services to the markets. The difficulties created by marketing problems curtail the ability of industry to provide added value and continue financing R & D. The conservative attitude of politicians has been inimical to the progress of privatisation. Without privatisation, Iranian economy will continue in its present form to the detriment of the wealth of the nation."

The transfer of technology with particular reference to Iran, has to be regarded as fundamental to the success of Iran's industrial base. This being so, it is vital for all relevant sectors of the economy to understand the urgent need for change. Nurkse said that "nothing can be done in underdeveloped countries until every thing has been done".

The following recommendations are offered as possible ways of utilising tech transfer in Iran's automotive industry:

- On the Hard-ware

1- Joint Investment with the goal of Tech. Transfer within the context of motor production, Gear Box, axel,...
2- Use of Multipurpose and/or flexible Machine tools, to accommodate new models & engines
3- Investment in manufacturing auto-body frames.
4- Attention to costumers desires & preferences for shapes and colors for example.
5- Investment in manufacturing high quality auto parts. .

- On the Human ware

1- Improvement in the ratio of specialist & expert operatives to total number of workers.
2- Provision of practical education for semi - skilled and unskilled workers
3- Increased cooperation with well known research centers in the world.

- On the info-ware

1-Provisoin & Application of practical software in motor designs, structure, body etc.
2- To equip the domestic R & D centers.

-On the org-ware

1- Sustainable improvement in production capacity, auto quality, cost effectiveness and price reduction.
2- Considerable attention to management quality.
3- Emphasis on auto-design & accomplishing production targets.

References

1- Abramovits, M.,(1970), "Resource and Output Trend in Unites States, Since 1970". American Economic Review, Papers and Proceedings of American Economic Association, 46, May.

2- Arrow. R., J.,(1962), "the Economic Implications of Learning by Doing" , Review of Economic Studies.
3- Atul Wad, (1998), "The Policy of Science and Technology", Translator: Larijani, F., Faslnameh Syasate Elmi va Pazhoheshi Rah- Yaft, No. 18 - Spring & Summer.
4- Azarang A.(1990), "Some issues and views about Technology", Moasesseh Farhanghi Nashre Darya, Tehran.
5- Banik, A,(2000), "Technology Transfer in Asia : Case of latecomer industries", New Delhi 110016, India, oct 27, [www.nda.sdnl net.in].
6- Buttrick, J.,(2000), "Toward a theory of Economic Growth: the Neclassical Contribution" Ibid.
7- Cooper, C.(1974), "Science, Technology and Development: the Political Economy of Technological Advance in Underdeveloped Countries", London, Frank Cass.
8- Denison, E.F (1962), "the Sources of Economic Growth in the Unites States", New York.
9- Ergas, Henry, (2000), "A study on Strategy and Policy in Auto Industry in Iran And its comparison with some other countries", Sapco,s R. & D, Tehran.
10- Ergas, Henry, (2000), "Statistical Results and the Procedure of Providing Parts Technology", Parts Manufacturing Society, Tehran.
11- Ergas, Henry,(1998), "A Comparative Study on Micro Tech. Policies", Translators: Taghavi Gilani and Malekifar, Moasesseh Amooseshi va Tahghight Sanaye, Defaee, Tehran.
12- Ernst, D., and D. O'Connor,(1989), "Technology and Global Competition: the Challenge for Newly industrialized Economies Paris, OECD.
13- Evnson, R, and G. Ranis,(1990) "Science and Technology: Lessons for Development Policy", Boulder, colo: West view.
14- Forsyth, D.,(1989), "Appropriate National Technology Policies", Geneva: ILO.
15- Freeman, C.L.(1982),"the Economic of Innovation", London Frances Pinter.

16- Grossman G. M. and Helpman, E.,(1994),"Endogenous Innovation in theory of Growth" the Journal of Economic Perspective, Volume, 8 , Number 1, Winter.

17- Hillebrand, W. , Messner, D. , Meyer-Stamer, J. , (1994), "Staerkung Technology cher Kompetenz" , DIE, Berlin.

18- Hirshman, A.O.(1985), "the Strategy of Economic Development", Yale u. P. New Haven Conn., Yale University Press.

19- Kaplinsky R. Cooper C.(1992), "Technology and Development in the Third Industrial Revelation", Moassseh Chap va Entesharat Vezarat Omoor Kharejeh, Tehran.

20- Kaplinsky R. Cooper C.,(1994), " Management of Science and Tech. in Transit Countries" , Scientific Research Center, Tehran.

21- Kaplinsky, R.(1989), "Technological Revolution and the International Division of Laber in Manufacturing: A Place for the Third world " Journal of Development Research, June. No.1.

22- Kuznets, S.,(1959), "the Meaning and Measurement of Economic Growth" six Lectures of Economic growth, Glencoe 111.

23- Kuznets, S.,(1966), "Modern Economic Growth: Rate, Structure and Speed", Yale University Press, New Haven.

24- Menck, K. W,(1987),"Technology politic und Technology-Transfer in Entwicklungslaender" in: Technology und Entwicklung, Hrsg.: Deutsche Stiftung fuer international Entwicklung Bonn.

25- Menck, K.W./ Gmelin W,(1987), "Wissenschaft Technology und Entwicklung- eine forlaeufige Zwischenbilanz", in: Technologies und Entwicklung, Hrsg.: Deutsche Stiftung fuer international Entwicklung, Bonn.

26- Musson , A. E.,(1972) "Science, Technology and Economic Growth in the Eighteen Century" , Methuen and co Ltd , England.

27- Nawaz Sharif, (1988), "Management of Technological Transfer and Development", Planning & Budget Org., Tehran.

28- Nawaz Sharif, (1990), "Tomorrow's Technology and Technology of Tomorrow", Tehran.

29- Nikoueghbal A. (1998), "Social Market Economy", Entesharat Samt, Tehran.

30- Nikoueghbal A. (1999), "The Theories of Management and Organization", Entesharat Samt , Tehran.

31- Nili, (2003), "Industrial Renewal Depends on Changing the Micro Economic Attitude", Tech. & Research Journal, No. 17, Summer.

32- Perez, c., (1989), "Technical Change Competitive Restructuring and Institutional Reform in Developing Countries", World Bank, Discussion, Paper no 4, Strategic Planning Review, Washing D.C.

33- Romer, P. M,(1990), "Endogenous Technological Change", Journal of Political Economic, October.

34- Romer, P., M.,(1994), "the Origins of Endogenous Growth", Journal of Economic Prospective, Volume 8, No 1.

35- Schumacher E.,(1980), "Small is Beautiful", Translator, Ramin A. Entesharate Soroush, Tehran.

36- Schumpeter, J. A.,(1988), "the theory of Economic Development" first published in German in 1911, translates in English in 1934, Cambridge, Harvard University press, reprinted in 1961. See also Roy, S.K. "Economics of Development", prentice hall of India Private Limited New Delhi.

37- Schumpeter, J., (1996),"Capitalism, Socialism and Democracy", Nashre Markazi, Tehran.

38- -Spengler J.J.,(1994), "John Stuart Mill on Economic Development" in Hoselitz, op.cit.

39- Spengler, j.J., (1960), "Mercantilist and Physiocratic Growth Theory", in Hoselitz B.F. "Theories of Economic Growth", the free Press of Gelencoe, Illinoise.

40- Standle, k.H,(1987), "Prioritiaten and Perspektiven fuer Wissenschaft and Technology im Dienste der Entwicklung" in: Technologies und Entwicklung. Hrsg: Deutsche Stiftung fuer international Entwicklung, Bonn.

41- Stokey, N.,(1991), "Human Capital Product Quality and Growth" Quarterly Journal of Economic.

42- Valibeigi H.(2003), "Competitive Advantage and Competition in Auto Parts Industry", Institute For Trade Studies and Research, Tehran.

43- Young, A.,(1993), "Invention and Bounded Learning by Doing", Journal of Political Economic.

44- Young, A., (1989) " State of Science and Technology for Development in the World: Options for the Future", UNCTAD, New York.

45- Young, A.,(1991),"Learning by Doing and the Dynamic Effects of international Trade", Quarter Journal of Economics.

46- Zanjani M. (1999),"Measuring of Tech. Level in Iran Industries", Markaz-e-Khadamat Khodkafaee Iran, Tehran.

47- Zanjani M., (1990),"Atlas Technology", Planning and Budget Org., Tehran.