DESIGNE OF A TECHNOLOGY CENTRE:
A Vehicle for Industrial Development

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ABSTRACT

This paper deals with the design of a Technology Centre to meet the needs of industries and enhance the industrial development activities in Ethiopia. The article addresses problems and constraints of industries in developing countries with regards to raw materials, skills, technology master plan, R&D, maintenance and industrial management. Furthermore the basic techniques and mechanisms of technology transfer are presented. For the Technology Centre under consideration the appropriate technology is selected using the point system method while the product families are chosen using ranking method.

Based on the selected technology and the product families, the Centre is designed so as to accommodate facilities for manufacturing, training, consultancy, maintenance and distribution. The Technology Centre is intended to serve the Eastern and Southern African countries. The model used in the design of the Centre may be modified and be implemented in another context.

INTRODUCTION

What distinguishes the 21st century man from its predecessors lies in the capacity to produce goods and services of better quality and quantity. If the technological capacity of a country is to be assessed, a much greater role has to be assigned to the means of practice needed for translating the general concept of technology as "capability" into actual "capacity" to produce goods. Technology can be defined as a capability and knowledge of how to do things to accomplish human goals. It is in fact a combination of equipment and knowledge. Looking back to the history of technological transformation, one could acquire better perspectives of technological growth. However, many specific factors have influenced the growth of developed countries and these divergent national experiences cannot be simply applied to the developing countries [1,2].

The period since 1950 was a golden age of growth for the international community. Both developed and developing countries scored an unprecedented economic growth rate since the Industrial Revolution. The trend is more pronounced for developing countries, most of which emerged from colonial dependence during this period.

However, despite the accelerating pace of scientific advance, all developing countries, though in varying degree, are in state of technological dependence [3].

The kind of capital goods developing countries import largely depends on their capacity to produce them domestically [3]. The relatively more industrialized developing countries, with such capacity mainly import capital goods consist embodying sophisticated technology. Where as the less industrialized countries, that have less capacity to manufacture, import capital goods in their fully assembled form. Developing countries are however trying to undertake a good proportion of assembly (in accordance with) of imported components.

Still the industries in developing countries have disregarded the reality in indigenous market potential. Most industries aimed at substituting imported consumer goods and, hence were directed to urban centers, while the majority of the population lived in the rural areas. Their failure to widen their market to rural areas contributed to forcing most of industries in developing countries to operate below capacity shortly after the rapid growth at their early stages. In most developing countries, there are no policies that provide low interest rates that promote industrialization process. Infant industries are thus left to compete for scarce financial resources (domestic and external) against services of speculative activities.

PROBLEMS AND CONSTRAINTS

Industrial surveys conducted in developing countries clearly indicate serious problems: as antiquate equipment unreliable, expensive, qualitatively not satisfactory raw material supply; scarcity of spare parts; weak management and organization; and high market competition [4,5,6,7].

At the root of most of the problems lies weak industrial planning which in most developing countries fails to put sufficient emphasis on such aspects as research and development (R&D) as well as training. [8].

Skill formation is closely related to capacity to undertake R&D activities, i.e. the capacity to adapt and generate technology. Total expenditure on R&D in developing countries is insignificant and the size of full time R&D manpower is at least ten times less than the corresponding figures in most developed countries. The output of scientific papers coming from the average African country is roughly equivalent to the output of papers generated by a typical small college in the USA that has an active research program.

Furthermore, while it is essential for R&D institutions to establish a close relationship with the productive sector, effective linkages are often lacking. Research results, for example in the form of designs for more appropriate technologies, often gather dust instead of being tested and multiplied.

Lack of technology master plan has also contributed to the inexperience in the utilization and maintenance of equipment. In most industrial plants, equipment breaks down for want of maintenance. When foreign companies provide some maintenance, generally, its cost is such that it undermines the competitiveness of the industries concerned. Poor maintenance is also the result of insufficient planning in the procurement of spare parts and replacement components.

Moreover, maintenance related problems in developing countries result from lack of spare parts, improper maintenance procedures and weak administrative skills in maintenance shops. For instance, the vehicles in circulation are of various types and of many models. Many of them are so old that setting them for the spare parts is practically unthinkable. Cannibalisation and modification spare parts of other models are the main sources of spare parts. Furthermore, the technicians who are working in the field do not have the appropriate skills necessary for a proper maintenance. As a result, many errors appear during maintenance. It is not uncommon during repair to face damages, improper repair or adjustment, failure to detect problems and, surprisingly false removal and replacement of good parts.

Industrial enterprises management in most developing countries, has been characterised by insufficient planning with respect to raw materials supply, marketing, optimum production and manpower utilisation. The situation has generally resulted in financially inefficient enterprises that, far from generating investible surpluses, constitute a financial burden for the economy as a whole.

The low-level revenues and wide-income disparity in developing countries has, rendered the market incompatible to the mass scale production and developed market, requirements, of imported technologies. In the 70's modern technologies were imported without any (adaptation) to the domestic market, resulting idle capacities and subsequent diseconomies of scale, high production costs, inflation, non optimal use of other productive assets and a decline in export expansion prospects. The imported technology had a damaging impact on the developing country's economy for it had not been adapted to the market size.

TRANSFER OF TECHNOLOGY

There is widespread consensus that technological development is the solution to many of the problems, and the only way of pulling out developing countries from poverty and backwardness. Industry believed to create by far the best conditions for the efficient functioning of an economy, thereby maximizing national income and speeding up economic growth through enhanced capacity for domestic savings. The aim of industrial development is to raise peoples' standard of living by increasing the domestic production of consumer, intermediate and capital goods, thereby raising income expanding, markets, technology and employment [9].

Technology is broadly defined as the knowledge (know-how) processed by man that enables him to perform a particular task. It is understood as a system of knowledge, skills, experience and organization that is used to produce and utilize goods and services[10].

A technology transfer (TT) is said to be accomplished when the recipient understands and knows it deep enough to use adapt, modify or adjust it until it begins to spread within the recipient economy. Generally transfer of technology is the transmission of systems of knowledge, skill, experience and organisation, produced and/or used in one place for a given purpose, for application in another place and/or purpose (It has multifold benefits to both developing and developed countries [11,12].)

While there are several methods of classifying technology transfer, in essence there are two basic types. The first is *domestic transfer*, also known a vertical* transfer or adaptation process, which basically involves the flow of technology from one stage of research and development process to another. The second one is *international transfer*, also denoted as horizontal transfer or adoption process, which constitute the movement of technology from one culture of systems and methods for application in a different culture and location.

Any means of conveying the elements of technology, which may not be available in the recipient countries is a channel of technology transfer. There are several potential channels for transferring technology. The major ones are turn-key, technical enclave, licensing, joint venture, patent right, simple emulation, direct purchase of naked technology, purchase of embodied technology, purchase of technological services, education, site visits and on -job training, journals, seminars and the like.

Clearly, channels of transfer are numerous, however, most researchers agree that the two channels more preferred by suppliers in the field are foreign direct investment and licensing.

However, suppliers prefer some of the channels to others. Some of the reasons why suppliers might prefer foreign direct investment are: better utilization of financial and human resource, better market control, fear that licensing would just give away the valuable asset prolonged relationship due to the complexity of the technology and protection of product standards.

On the other side the reasons why suppliers would choose licensing are small local market, scarce human and financial resources, preclusion of investments by legal constraints and high political risk, to obtain cross licensing agreement, tax considerations and establishment of foreign patents.

However perfect a technique (mechanism) of technology transfer might be, there always are obstacles to its execution. Weak infrastructure, cultural differences, attitudinal diversities and communication gaps are some of the factors that hamper the smooth transfer of technology.

The information in developing countries is often scarce and unrealized, the factors that need consideration are many and further more the decision-makers are numerous. In addition, the fact that the examination of a technology option should be done by such factors as quantity, quality and others that are interrelated, but not by considering short term benefits and loses alone makes technology selection a complex task for a developing country.

The availability of more than one technological option has many advantages. A plurality of options avoids a no choice "take it or leave it". It provides alternative routes most appropriate for the host country to manufacture a product.

TECHNOLOGY SELECTION

Selecting appropriate technology and the right products effects efficient technology transfer. To this effect an effort has been made by the author first to identify the right category of technology, which can further enhance the development of other industrial sectors and secondly the selection of the products to be manufactured in the Technology Center, Ethiopia.

Financial analysis is the most frequently used method for selecting one technology from a set of option that takes into account inputs and outputs in terms of costs and prices, the life of the project, time-related cash flow, discount rates of money, inflation and several other factors. It however doesn't directly weigh technological factors. Every technology has intangible costs, which to all intents and purposes cannot be measured in terms of dollars and cents.

It should be noted that, technology has in a triangular rather than linear relationship with market and investment. Market factors influence the choice of technology principally in terms of its viability with respect to product volume, product mix, product quality and the type of investment to be made. Choice of a technology profoundly affects investment and operating costs and the market potential of a country. Furthermore, political and social factors also influence the choice of technology. This inter-linkage makes the choice of the best or most appropriate technology a difficult task [13,14,15].

The entire range of manufactured and processed products may be divided into three broad classifications using the system developed to highlight groups of industries that can be readily reviewed by selectors in developing countries focusing on technology related factors.

I. Extraction - based industries: ores, minerals, coal, coal, petroleum etc.

II. Assembly - or - design - based industries: trucks, tractors, automobiles, machinery, appliances, furniture etc.

III. Process – based industries: metals, alloys, chemicals, refinery products, paints, food products, cosmetics, pharmaceuticals etc.

The alternative technologies categories listed above are evaluated by employing different methods. A method seldom used, in the evaluation of alternative technologies with many intangible costs, is the Point System. The method takes into account the unquantifiable qualitative factors and the overall need for a technology (to be transferred) and breaks them down into so-called factors or considerations. (They may also be termed criteria or objectives.) Table 1 illustrates the Point System method and shows the qualitative factors that often need evaluation.

The three technologies are listed against the factors or considerations involved, or the expectations from the technology. The factors are defined so that they are clearly understood without duplication of terms as well as confusion of meanings.

Table 1: The Point System Method

Parameter or Factors of considerations	Point system	Alternative Technologies		
		I	II	III
1. Technology potential				
Capacity build up	100	80	100	85
Skill formation	50	35	50	40
2. Resource utilization				
Raw material supply	30	10	20	20
Involvement of existing industries	80	50	75	60
3. Investment and running cost				
Foreign currency	50	25	40	40
Local currency	30	10	25	25
4. Labor requirement				
Technical skill	30	15	30	25
Managerial skill	40	35	15	25
5. Power requirements				
Electric power	50	10	45	40
Fuel gas	25	20	15	15
6. Market adaptation				
National market	20	5	20	20
Regional market	50	50	45	20
7. Technology limits				
Technical	15	15	10	10
Legal	10	5	10	5
Total Points	**580**	**365**	**500**	**430**

The parameter, which the selector considers most significant, - the reference parameter - is assigned a weight of 100. Other parameters are also given respective weight by the selector considering their importance compared to the reference parameter (by definition, they are valued at less than 100). This gives rise to point system scale.

Using the Point System scale, the selector attempts to establish a point score by grading higher points to a parameter if the technology is favored by it and lower if it is less favorable. This establishes a vertical scoring component.

With the reference technology thus scored, all other candidate technologies are compared against it parameter by parameter, and are rated, in accordance with the horizontal scoring component of the methodology.

Totalling the points obtained by each competing technology yields a ranked list: technology II with 500 points followed by technology III with 430 points and technology I with 365 points, favouring the selection of technology II assembly or design-based industries of trucks, tractors, automobiles, machinery, appliances, furniture etc.

Among group II industries, it is evident that in the process of assembly or production of trucks and tractors, large proportion of the technologies are in themselves well known, not particularly complex and therefore accessible. This leads to the progressive establishment of domestic component production, which in turn will help to accelerate technological capability build-up not only in the automotive industry sector but in all the other industrial sectors as well. The fact that truck and tractor assembly lines, contributes not only increase in productivity, employment and incomes, but also indirectly through backward and forward linkages to the growth of rural-based manufacturing and expansion of employment. Furthermore, the existence of FIAT-IVECO truck assembly plant in Addis Ababa and the development of some ancillary industries like MARU Metal plc and Mesfin Industrial Engineering PLC direct us to develop the Technology Centre towards the assembly of trucks and tractors in preference to the other industries in Category II.

An assembly of a truck and/or a tractor involves some hundreds of major parts and tens of thousands of parts if every nut and bolt is counted. Such products have a power train (engine, transmission, drive shaft and axles), body and chassis and a wide range of attached parts such as tyres, batteries radiators, internal fittings etc. Necessary raw materials used include iron and steel and other metals, rubber, plastics and glass.

The issue at this junction is to identify products by means of which the technology to be transferred could be properly absorbed and utilised by the recipient economy. To this effect the parts are grouped together into families of products by their similarity either in geometric shape and size, or due to the similarity of processing steps required in their manufacture or the material used for their production.

Family A consists of products formed of sheet metal like body, chassis, supports, pipes, mufflers, radiators and so on. Family B is composed of shafts and gears of different types. Family C covers products of sealing and friction components like gaskets, brake pads and friction plate pads. Products in family D are the engine block, pistons, piston rings, valves and so on. Plastic components like rear light lenses, dashboards, water containers and battery casings form family E. Preparation of reflectors, windscreens, mirrors and other glass components form the F family. Finally the electrical and electronics components are grouped under family G.

The technologies of the product families are evaluated using ranking method, whereby technologies are awarded proficiency marks, that is, ranked, with the highest number assigned to the technology most proficient in the use of each parameter, (5 is excellent, 4 is very good, 3 is good, 2 is satisfactory and 1 is poor) A more rewarding method is to rank technologies after weighting scarce inputs or constraint factors. For the purpose of comparison of the seven product families, five criteria are established taking into account the practical limitations.

- Fixed investment in national currency to be optimized;
- Running costs to be minimized;
- Products are made less complex;
- High impact of technology transfer on the other sectors;
- Need for highly skilled labor to be minimized.

The weight of the parameters in Table 2 is derived as follows:

$$Weight = WR = \frac{R}{Y} \times Wt$$

Where

- R = Rank of parameter in the particular technological process.
- Y = Highest rank number weight of that parameter among compared technologies.
- Wt = Assigned weight to parameter.

For example, the weighting for skilled labour for technology *B* is as follows: $WR = 2/5 \times 0.25 = 0.10$; two is the ranking for the skilled labor parameter and five is the highest rank received by any one technology on that parameter (table 2); 0.25 is the weight given to the skilled labor parameter.

It is believed that the most important criterion is TT impact on the other sectors followed by need for skilled labor to be minimized. Then comes the factor fixed investment in national currency to be optimized followed by considerations like making less complex products and minimizing running costs.

The product family with the highest weighted cost (i.e. the technology that uses scarce resources most efficiently) is, of course, to be preferred. In our case, product families *A*, *C*, *E* and *F* are particularly proficient when overall cost parameters and the impact on scarce resources are considered. Product families *D*, and *B* however, are not in any way proficient when overall parameters are considered while product family *G* is moderately proficient.

Table 2: Ranking method

Parameters	Wt	Alternative Product Families													
		A		B		C		D		E		F		G	
		R	WR	R	WR	R	WR	R	WR	R	WR	R	WR	R	WR
Investment cost	0.20	4	0.16	2	0.08	5	0.20	1	0.04	4	0.16	4	0.16	3	0.12
Running cost	0.10	4	0.08	3	0.06	4	0.08	2	0.04	4	0.08	5	0.10	4	0.08
Complexity of technology	0.15	5	0.15	2	0.06	4	0.12	1	0.03	4	0.12	4	0.12	3	0.09
TT impact on the other sectors	0.30	5	0.30	3	0.18	4	0.24	2	0.12	5	0.30	4	0.24	4	0.24
Skilled labor	0.25	5	0.25	2	0.10	5	0.25	1	0.05	4	0.20	4	0.20	3	0.15
Weighted total	1.00		0.94		0.48		0.89		0.28		0.86		0.82		0.68
Ranking			7		2		6		1		5		4		3

The method has been used with caution, as it is possible for a selector to assign too many points to a relatively unimportant parameter. Injudicious weighting on the points systems scale may seriously compromise the measurement the propriety of the overall technology. The points system method takes into account the qualitative factors that cannot be quantified or weighted. However, like ranking methods, it involves problems resulting from subjectivity.[1]

Still, of the product families selected using ranking method, the Technology Centre will be involved in the production of sheet metal forming, exhaust pipes, radiators, glasses, plastic components, rear light lenses, batteries, gaskets, brake pads and the like. These products have been identified in consultation with FIAT - IVECO experts, as part of the local integration program of Automobile Manufacturing Company of Ethiopia (AMCE -IVECO).

[1] When more than one person carries out the rating, as it is usually the case, the convergence of the evaluation process can be tested by the Spearman rank correlation coefficient, R [14].

$$R = 1 - \frac{1}{n(n^2-1)} 6\sum_{i=1}^{n} D_i^2$$

Where D_i = rank difference and n = number of technologies being ranked. The correlation coefficient is equal to 1 when the rankings are identical and -1 when they are opposed.

Where more than two evaluators are available to select technology, the method that calculates the coefficient of concordance is more useful for testing a selection. The coefficient of concordance, W, is expressed by the following relationship.

$$W = \frac{12 \times S}{m^2(n^3 - n)}$$

Where m = number of evaluators, n = number of technologies evaluated and S = the sum of squared differences between the observed rank total and the expected total of null hypothesis. W varies from 0 for random evaluation to 1.0 for perfect concordance.

THE PROJECT IDEA OF LOCAL INTEGRATION[2]

There have been sporadic attempts by national and international organizations to solve the problem of technological under development. Some of the efforts made are establishments of industrial plants, design centers, scientific and technological institutions and the like, in addition to the seminars, workshops, trainings abroad and advisory services at different levels [16]. The effort made by many governments, donor organizations and international agencies is undoubtedly remarkable and has addressed the problem to a certain extent. However, the attempts lack coordination and fall short of making the maximum out of the existing under-utilized industries, reforming the weak regional co-operation, as well as making the industrial ambient attractive to investors and strengthening the link between science, technology and production.

This project idea is an attempt to make a conscious and co-ordinated effort in order to make use of the existing under-utilised industries, to exploit best regional resources, to create a conducive investment environment, to create local technological and capability build-up and to strengthen the link between science, technology and production.

The project doesn't attempt to duplicate what has been done elsewhere, nor does it pretend to create an institution giant enough to pride the nation. But, it intends to create a "Technology Transfer Vehicle" to organise co-ordinate and assist the existing institutions towards a common goal of industrial development. To this effect, the Centre will have a close contact with international, regional and national enterprises as can be seen in the model (Figure 1). The main objectives of the centre could be summarised as follows.

1. Increase the impact of co-operation efforts on the revitalisation of industries by making the best use of national experts and the experience gathered in the countries of the region, and by strengthening complimentary or national industries at the regional level.
2. To promote and establish multinational enterprises, identify cases and assist in designing appropriate forms for inter-country cooperation, test existing national and sub-regional legislative framework and economic conditions promoting or impeding such cooperation.
3. To give direct technical assistance to enterprises in revitalizing, restructuring and relocation of firms.
4. To offer assistance to groups of enterprises catering the same market, manufacturing similar products and processing similar raw materials.
5. To contribute to the improvement of the system of economic management, with reference to the rehabilitation cases in the country and possibly in the region.

It is the author's firm belief that manufacturing technologies in developing countries can be progressively adapted in ways appropriate to prevailing circumstances. The starting point in the generation of local technology is the unpacking of imported technology and the progressive fitting of domestic technology into the total mix required to implement the country's development policy and development plan.

PROJECT STAGES

Based on the output of the ranking method, the program of local integration is divided into four stages [17,18,19,20]. Stage one is the most elementary, while stage four is more complex and require a more developed technical as well as managerial capability.

The first local integration stage concentrates on the most preliminary components, which in part are already in production. At this stage, it is assumed that the existing local ancillary industries are suitably equipped and availability of raw materials assured to produce the following:

- Number Plate Support*

[2] The project idea and the figures presented in this article are adapted from *"TECHNOLOGY TRANSFER FOR INDUSTRIAL DEVELOPMENT: A Technology Centre for Eastern and Southern African Countries"* Doctoral dissertation in Industrial Engineering, Nov. 1998, Politecnico di Torino, Italia – by Daniel Kitaw

* These are products to be manufactured by the Technology Centre if they are not already in production by local ancillary industries.

- Bumper Support*
- Radiator Support*
- Rear Fender*
- Cargo Body*
- Bus Seats*
- Tipping Body (Excluding Hydraulic System)
- Bus Body Structure*
- Front Bus Bumper*
- Rear Bus Bumper*
- Roof Luggage Rack*
- Inner Luggage*
- Rack Front Cowl Metal Structure*
- Fuel Tank Bands And Brackets*
- Leaf Springs - Front/Rear
- Air Tank Brackets And Bands
- Steering Support Brackets*
- Spare Wheel Holder*
- Battery Holders
- Tools Box
- Fuel Tank
- Dash Board
- Oil Sump Guard*
- Mats
- Upholstery
- Tires
- Batteries*
- Paints
- Mufflers*

The second local integration stage is assuming a more developed production capability of other complimentary industries. At this stage, it is assumed that suitably equipped new ancillary industries are set-up in order to manufacture:

- Gaskets for Engine*
- Tachometer Cables
- Starter Cables
- Fuel Cables
- Speedometer Cables
- Gaskets for Exhaust/Intake Manifolds*
- Rubber Manifolds and Pipes
- Rubber Moldings
- Silent Blocks
- Driving Belts
- Miscellaneous Fasteners and Brackets*
- Inner Trimming Panels
- Windscreen Washer Tank
- Springs, Miscellaneous
- Brake Drums (Machining)
- Clutch Oil Reservoir
- Flexible Fuel Pipes*
- Water Radiators*
- Brake Pads*
- Glass Panes*
- Mirrors
- Tools kit
- Clutch Disks
- Flexible Metal Exhaust Pipes*
- Switches, Electrical
- Air Tanks
- Pedals and Control

The third local integration stage assumes that aluminum and cast iron foundries are set-up together with suitable machining facilities, so that the following components could be manufactured.

- Axles, Shafts
- Steering Linkages
- Stabilizing Rods
- Valve Guides
- Valves
- Steering wheels
- Pistons (foundry and machining)
- Valve Rockers
- Clutch Release Control
- Alternator
- Starter Motor
- Engine Supports
- Connecting Rods
- Brake Drums (casting)
- Leaf Springs Holders and Links
- Axle Body
- Steering Knuckles
- Spooked wheels
- Piston Rings
- Windshield Wiper Motor
- Brake Shoes
- Head and Front lamps
- Side and Rear (Tail) lamps*

The fourth local integration stage is the phase where the transfer of technology is well advanced so as to absorb technologies, which need high level of technical and managerial skill. The manufacturing of the following items assume availability of well equipped foundry and forging facilities:

- Engine Cylinder Head
- Engine Crankcase
- Timing Shaft
- Crank Shaft
- Miscellaneous Gears
- Bevel Gear and Pinion
- Transmission Shaft

There are two main elements in the gradual acquisition of technological capability. The first is the progressive establishment of domestic components production (the road to be taken is bound to differ from country to country); and the second is acquisition of the design and engineering skills without which technological know how cannot be absorbed and manufacturing techniques adjusted to local conditions. A major development during the stages of integration is the growth of local knowledge of technology and of multipurpose machine shops that could manufacture replacement parts for much of the machinery and equipment used in the region[3]. To this effect the manufacturing division of the Centre is composed of different shops and appurtenant facilities. In order to achieve maximum utilisation of the machinery and process materials, departments, which have close relationship, are placed adjacent to one another (Dr. No. 01 & 02). The workshop will also accept parts, semi-finished products, from various client industries.

SERVICES OFFERED BY THE CENTRE

When the available technology and skills are incompatible, either the technology needs to be adapted or the skills improved. At different levels, training enables workers to contribute to improving product quality, to adaptation of technologies, and to innovation. The Technology Centre will be involved in carrying out various training activities at different levels to meet the wide spread demand for higher managerial capability and skilled labour in the country. It is planned that the Centre will have an organised theoretical and practical training facilities for: metal carpentry and welding, machine shop, auto mechanics shop; informatics branch, electronics maintenance shop, and various class rooms and conference centres (Dr. No. 01 & 02).

The central element in the process of generating domestic technology and making the best choice and use of imported technology is consultancy services. The Centre exerts an effort to be built up consultancy services, as per the size of the country and the sectoral breakdown of production, both present and planned. The impetus provided by the establishment and progressive expansion of local consultancy to the development of domestic technology in the widest sense of the term may be a stimulus to: research and development; strengthening local technical competence; implementation of the research output, technology selection and local fabrication.

In many developing countries it is common practice to meet quiet a number of qualified persons who are employed in areas, which have little or no relation with their studies and earlier experience. It may turn out that although they are properly employed, their training and experience is not being fully used and it is almost certain that such people would obtain considerable personal satisfaction from an involvement in an important development programme as advisors and consultants at the Technology Centre.

Without product development there is nothing to produce or distribute while without higher productivity the product or service is likely to be too expensive for the markets of developing countries. Without efficient distribution network it matters very little what might be produced or how well it might have been produced [21,22,23].

The concept of logistics is to ensure the availability of the right product or service in the right quantity, and in the right condition, at the right place, at the right time, for the right customer, at the right cost. Efficient and effective service operation largely depends on the existence of a good warehouse with high degree of material accessibility, material flow patterns and locations of traffic bottlenecks, labor efficiencies, personnel safety, and warehouse security [24]. In this regard the Center is designed to accommodate a central warehouse and a well equipped central vehicle maintenance shop.

For the provision of maintenance services and spare parts the Centre will make use of the regional network. It is assumed that the COMESA regional network is to be used for the distribution of parts and services.

The major contributors to the maintenance problem are personnel composition, personnel training, vehicle technical composition, vehicle technical literature, and vehicle diagnostic and repair equipment. The solutions to the problem, offered by the Centre, comprise proper equipment, adequate maintenance procedure, skilled personnel and proper data analysis. Result of the analysis will lead to improved vehicle performance, improved fuel economy, optimised

[3] The region under consideration in this article covers the Eastern and Southern African countries under COMESA.

maintenance scheduling, accurate inventory control and lower maintenance cost [25,26]. The maintenance branch of the Centre has three levels of maintenance services, from simple to complex operations.

It is evident that the development of the Centre and its envisaged activities in the years to come depends on the overall industrial policy and stability of the country, regional co-operation as well as on the implementation programme for the ancillary industries.

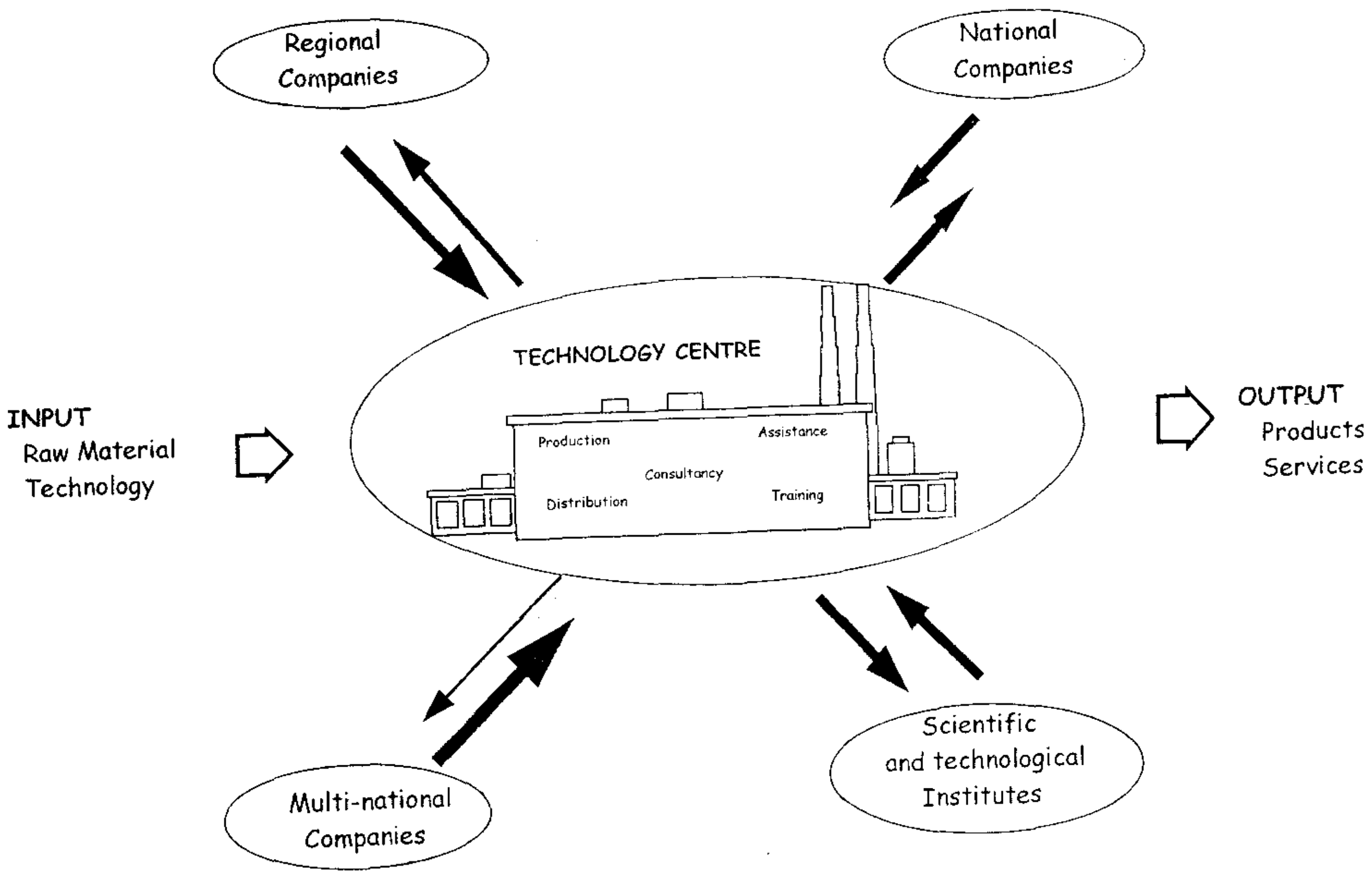
CONCLUSION

Most scholars agree that the solution to all the problems described would be the accelerated industrial growth of developing countries. On the one hand, it is important to realize the political and financial difficulties involved in adopting a programme of accelerated massive economic growth in developing countries and secondly it is equally important to recognize that such a growth could not be achieved following the same pattern adopted by advanced western economies.

On the other hand, industrial development requires creativity, strong leadership and international consensus on accelerated industrial growth of developing countries, all of which are currently missing. The existing forums for the development of global economic and industrial policy initiatives are clearly inadequate.

Prosperity comes from successful technology transfer and product development. The essence is understanding and applying new technologies, skills, application of experience and know-how to new and changing problems of design, of efficiency and of production.

Therefore, the rapid and massive economic growth of developing countries can only be achieved if appropriate technologies are transferred to produce competitive products and services that are geared to satisfy global consumption.



Industrial enterprises, both existing and new, have to be the main actors involved. The research and technological institution along with the inventive elite may be key players. They have to be capable of catalyzing the required sub-regional, national and supra-national policies, of mobilizing and strengthening innovation support institutions, seizing partnership opportunities and effectively manage the corresponding massive technological innovation processes needed to achieve sustainable competitiveness.

In practice, the success of developing countries' enterprises in seizing these opportunities will highly depend upon their commitment to radically increase their qualitative and quantitative technology management capabilities.

To this effect the Technology Center addresses the central issue of accelerated industrial growth of developing countries. The objective of the Center, in short, is to exert a conscious and coordinated effort in order to make use of the existing under-utilized industries, to exploit the regional resources to the maximum possible, to create a conducive investment environment, to create local technological and capability build-up and to strengthen the link between science, technology and production.

The Center is designed to serve the eastern and southern African countries. However, the project idea can be modified to fit in a particular context of a specific territory. It may be presented in many forms, from a highly complex, capital-intensive technological center for countries where the basis for the transfer of technology is very week, to a virtual plant with low investment for countries with adequate technology transfer base.

Most, if not all, of developing countries have more or less similar levels of social, economic, and industrial infrastructure developments. The Center may be considered as a technology transfer model, which can be adapted to any other developing country.

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