

**Technological Transfer and Adaptation by Multinationals' and Foreign Joint Ventures' Operations in the Mauritian Export Processing Zone.**

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**Abstract**

The paper reviews survey evidence on the level of technological transfer and adaptation by MNEs' and foreign JVs' operations in the Mauritian export processing zone. The evidence suggests that the majority of the foreign firms adapted their imported technologies, even though surprisingly the main type of adaptation was for using a less unskilled labour pool. The data also revealed the commitment of a number of these firms to continually improve upon their production processes which are vital for their future growth and success, even more so in view of the emergence of competing low-cost centres and the advent of the World Trade Organisation. Furthermore, there is support for the proposition that these foreign firms' technologies were, in general, lower when compared to those used elsewhere within their groups. Finally, there was a distinct belief among both sets of companies' directors that indigenous firms' technological bases were comparable to, and even outweighed, in some instances, their own in-house production technologies.

*Key words*

Competitive strategy; economic development; export-processing zones.

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### **Introduction**

The interaction between foreign direct investment and technology is considered to be of paramount importance in the discussion of the foreign investment issue, both for the investing and host countries. The reason is to be found in the alleged benefits that technology confers on all parties. Indeed, technology may be regarded as the lifeblood of economic growth, accumulation, trade and even changes in the organization of social relations and the relations of production.

The benefits accruing to a recipient country from the transfer of technology by a more advanced nation are well documented<sup>1</sup> in the economic literature. It has been established that technological development plays a vital part in the industrial success of developing nations, as it does in developed countries (Lall, 1990). Developing countries need to develop new skills, knowledge, institutions and organizational structures to master the technology they import and to grow efficiently.

In general terms, these benefits may be summarized as follows: firstly, it enables less developed countries to substitute an imported good for a local one without overtaxing the balance of payment; furthermore, the transfer of technology creates employment and increases national wealth. The provision of new techniques has the educational effect of transmitting knowledge to the local population. Thirdly, it helps a country to develop through the exports of manufactured goods, more specifically those with limited domestic markets and finally it affords the possibility of improving service facilities such as the banking systems.

However, apart from direct linkages, technological transfers by multinationals may provide substantial indirect benefits, usually referred to as spillovers, to the host country. Beneficial linkages may include the spillover of skills and efficiency to local firms, partly from externalities created by the multinationals and partly from increasing competitive pressures on local firms in product and factor markets.

Furthermore, the choice of the techniques transferred by multinationals has a major bearing on the benefits derived by the host countries. For example, the transfer of a specific technique (labour intensive) which suits the factor endowments (abundance of labour) of the host nation, is bound to confer greater employment benefits on the latter.

More importantly, however, the extent of the benefits derived by the recipient nations from such technology transfer is very much dependent upon the appropriateness and suitability of the technology to the circumstances prevailing in those nations.

The question of appropriateness of technology both relates to both products and processes. Products manufactured by local affiliates of multinationals are often criticized for being too sophisticated, too highly designed and too well packaged to meet the needs of low-income local people. Instead they cater to the consumption demands of the elite. Such products are usually associated with highly imperfect oligopolistic markets where advertising and marketing skills play a crucial role.

Even more important is the inappropriateness of the productive processes, particularly where they are excessively capital intensive in relation to the abundance of cheap labour in the host countries. If they are, the balance of payment is worsened by excessive importation of capital equipment and the employment problem is aggravated and inequalities of income are worsened.

Such issue of appropriateness is part of a larger debate on the suitability of modern technologies to developing countries (Stewart, 1977). The original concern was a static neo-classical one: overly capital-intensive technologies were used in relation to developing country factor endowments. Over time, other concerns were added: the technologies did not create local linkages or build on indigenous skills; they were used to produce inappropriate products; and they were rigid and unadaptable to local conditions.

Nevertheless, the condemnation of MNEs' technology being inapt, may be exaggerated given that the foreign firms, in some cases, do adapt their imported technology<sup>2</sup> for certain specific reasons. Furthermore, surveys<sup>3</sup> have shown that, under certain specific circumstances, using capital-intensive techniques in developing nations may be more appropriate and cost effective.

Process adaptation may be influenced not only by host government policies but also by the attitudes and policies of the multinationals themselves. In any of their operations in the Third World, foreign companies do modify their production processes to take into account the smaller size of markets and the availability of abundant low-wage labour. But, because of low levels of skills and productivity in many developing countries, cheap labour may turn out to be expensive to use in production. Companies therefore resort to more capital-intensive processes both to reduce costs and to ensure quality, uniformity, and dependability of output.

Furthermore, a key factor governing technological selection, and hence adaptation<sup>4</sup>, is the nature of the target market area. For example, there are strong suggestions that export-oriented investments may involve less adaptation than import-substituting ones.

The multinationals' country of origin may also have an effect upon the selection of, and the degree of adaptation to, the technology transferred. Several studies of multinationals from developing countries have indicated that the competitive assets of these firms are different from those of their counterparts from industrialized nations. These firms usually do not have the advantage of brand names or consumer loyalties. In most cases, they operate in industries using standard technologies (Wells, 1977, 1980, 1981; Lecraw, 1977, 1981).

Also studies on these developing countries' multinationals have indicated that their sources of competitive strength follow from a different set of conditions and factors. These firms have been able to acquire or develop labour-intensive, multipurpose technologies that need very low degree of adaptation and that can operate at a lower scale of production (Wells, 1978, 1980; Wells and Warren, 1979).

Another method of assessing adaptation in technology transfer is to compare multinationals' technologies not with its equivalent in the industrialized countries, but with its equivalent amongst indigenous firms. Here there are very strong reasons to believe that multinationals' technology may be biased towards capital intensity. The indigenous firm, by virtue of its greater knowledge of the labour market, is likely to be able to hire labour cheaper than a foreign user of imported technology, whilst the foreign investor is very likely to have access to cheaper capital because of its reputation in the financial markets of the industrialized countries. Furthermore, given the direct relationship between the industrialization level of a country and the level of technological accumulation, there are very strong grounds for arguing that multinationals from developed nations are of a more capital-intensive nature.

Also it may be argued that multinationals exhibit higher capital intensity in that, given their ownership advantages and their market power, they are able to pass the higher costs of inappropriate technologies on to consumers (Lall, 1980; Newfarmer, 1985). On the other hand, others argue that such high capital intensity is merely a reflection that multinationals' managers are more alert to ways of decreasing costs by substituting capital for labour than local firms (Pack, 1976).

### **Analysis of Results**

The evidence comes from a survey of fully-owned subsidiaries and joint ventures, in the textile and clothing sector, operating in the export processing zone of Mauritius. The survey was questionnaire-based but executed through interviews, which allowed for qualitative elaboration of respondents views. In all 30 of the 32 operative fully-owned subsidiaries, and 36 of the 42 joint ventures, in the MEPZ in textiles and clothing were covered.

### **Adaptation of Imported Production Processes**

The directors of the foreign subsidiaries and international joint ventures were asked whether they adapted their production processes and their detailed responses are given in Table 1:

**Table 1. Motivations for Adaptation of Imported Production Processes**

	FO Sample			JV Sample		
	Yes	No	N/A	Yes	No	N/A
Not At All	9	16	5	6	23	7
Accommodate Local Raw Materials	1	24	5	1	28	7
Change Degree of Energy Use	0	25	5	0	29	7
Use More Unskilled Labour	6	19	5	8	21	7
Use Less Unskilled Labour	8	17	5	11	18	7
Avoid Shortage of Skilled Labour	1	24	5	3	26	7
Use Skilled Labour Available in Mauritius	4	21	5	12	17	7
Allow for Climatic Differences	0	25	5	0	29	7

The results for the fully-owned sample show that sixteen firms did adapt their imported technology in some ways, nine did not modify the technology at all while five firms were the only production sites within the group and/or they were producing a totally different product line and hence the issue of adapting their technologies did not arise.

On the other hand, twenty-three firms within the joint venture sample adapted their technologies, six companies used the production processes transferred unchanged, while for the seven remaining companies, the Mauritian zone was their sole manufacturing site.

The first major inference that can be drawn from the fully-owned subsidiary data is the relatively substantial number of firms (9 firms – 30%) which did not adapt their technology at all. The most common reason advanced by the directors for not adapting their imported production processes was to safeguard the quality of their products. The directors reasoned that using the same sophisticated processes as in their home countries (often relatively more capital intensive) ensured that they were able to maintain the quality standard of their products and also ensured they were able to meet their buyers' product specificities.

Furthermore, the types of products that were manufactured by most of these companies were highly sophisticated and these required high precision techniques and specific methods of production. In this light, the directors argued that the

imported technologies could not have been modified or adapted in any way to suit the factor endowments of the host country.

On the other hand, for the joint venture sample, only six (13.7%) companies did not adapt their imported technologies. But the reasons advanced by the directors of those companies were very similar to those of the foreign subsidiaries. These included products and buyers' specificities, and safeguarding of quality standards.

The samples of firms that did not adapt their technologies were further segregated to see whether there was a 'country of origin'<sup>5</sup> effect. A very interesting pattern could be depicted for the joint venture sample whereby out of the six firms which did not adapt their technologies, four were developing countries' multinationals.

This in itself may be a very good explanation for not adapting the imported production processes given that the factor endowments present in these foreign firms' home countries were very similar to that of the host country. Interestingly, some of these companies' directors did indicate that their imported production processes suited the host countries' factor endowments.

However, for the multinationals' sample, no definite trend could be depicted given only four firms that did not adapt their technologies originated from developing countries.

On the other hand, the most frequently cited reason for adapting the imported technology for the multinationals, was to enable them to use less unskilled labour. This is very counterintuitive especially in view of the argument that multinationals usually adapt their relatively capital-intensive technologies to suit the host developing country's factor endowments, which is relatively labour intensive and where the level of skills is low. But this is not the case for multinationals in the Mauritian zone where eight firms adapted their imported technologies to enable them to use less unskilled labour.

Furthermore, the directors of these multinationals reasoned that the selection and adaptation of the imported technology to minimize the use of unskilled labour was mainly geared towards safeguarding and upgrading the quality of products that

they were manufacturing. They also argued that the use of more efficient techniques of production and skilled labour entailed greater productivity and hence greater return.

Curtailling the use of unskilled labour, as a motivation for adapting the imported technology, was also very popular among the joint ventures (11 firms). The main reasoning behind such decisions was also for gains in productivity and to speed up the manufacturing process. Nevertheless, many directors argued that the type of technology used, and hence the level of adaptation, was very much dependent upon the type of product manufactured.

Closely related to the above is the modification or adaptation of the imported production processes which will enable the manufacturing entities to use the skilled labour available in Mauritius. This was also a popular motivation for adapting the imported technologies among both sets of companies.

To use the skilled labour force available in Mauritius was in fact the main motivation for joint venture firms for adapting their technologies (12 firms), while for the fully-owned sample only four directors provided such reasoning for adapting their technologies. Nevertheless, the motives advanced for using skilled labour were very similar for both samples.

On numerous occasions, both sets of directors argued that using more skilled labour meant: gains in productivity, improvement in and/or safeguarding of quality, and less time spent on the manufacturing of products.

On the other hand, six foreign subsidiaries and eight foreign joint ventures did adapt their imported technologies for the purpose of using more unskilled labour. Such reasoning was to be expected in view of the more capital-intensive nature of the production techniques used by these foreign firms in their home countries. In these cases all the directors were adamant that the technologies transferred were too sophisticated for the local workers and they had to modify their production processes accordingly.

There is a relatively large pool of skilled labour available in the Mauritian zone nowadays. Unfortunately, this was not the case in the 1970s and 1980s, during which time foreign direct investment in the textile sector was at its peak. Such a situation may have prompted some firms to modify their imported techniques so that they were less skill intensive.

The shortage of a pool of skilled labour was the main motive for three joint ventures and one foreign subsidiary for adapting their technologies. The production techniques were rendered less skill-intensive which guaranteed that the skills required were available. The latter situation was deemed very important because it entailed that these companies were able to ensure a continuous flow of output and to meet their supply deadlines.

Furthermore, adapting the imported technologies to accommodate the use of local raw materials, was the motive provided by only one joint venture and also a single foreign subsidiary. Such decisions could be explained by the fact that these companies undertook processing tasks for other firms operating in the zone. They had to modify their technologies to accommodate for the raw materials that were being provided by other companies in the Mauritian zone.

Finally, directors of multinationals and joint ventures did not view ‘change in energy use’ and ‘allow for climatic differences’ as important criteria for adapting the imported production processes. Not a single director for both sets of companies perceived differing energy use and climatic conditions as motives for modifying the imported technologies.

### **Motivations for Altering Existing Production Technologies**

The directors of both sets of companies were also queried as to the underlying motives for altering the imported production processes. The evidence gathered is depicted in Table 2:

**Table 2 Motivation for Altering the Existing Production Technologies**

	FO Sample			JV Sample		
	Yes	No	N/A	Yes	No	N/A
Reduce Cost	15	1	14	18	5	13
Ensure Reliable Flow of Output	16	0	14	19	4	13
Ensure Constant Quality of Output	16	0	14	21	2	13

Irrespective of the types of modifications made to their imported production processes, multinationals' directors almost unanimously agreed that the underlying motivations for such adaptations were to curtail costs, to ensure a reliable flow of output and to safeguard the quality of their products. There was also an additional motive which was to ensure that the products were manufactured to buyers' specificities.

All the multinationals' directors agreed that guaranteeing a reliable flow of output and maintaining and/or upgrading the quality standards of their products were crucial for the survival of their firms. Failures to do so may entail decreases in the existing demand for their products and see their reputation negatively affected.

The importance attached to meeting these criteria is further accentuated given the market orientation of these firms. These firms are competing on a global basis, whereby the quality, as well as the cost, of the product exported, are critical. These export-oriented firms are expected to meet the demand for their products on a continual basis and to satisfy the set quality standards imposed by their buyers<sup>6</sup>.

Cost effectiveness was also very critical for these firms (15 out of 16). Adapting the imported production processes to suit the local factor endowments entailed a reduction in the unit cost of production and less time spent on training the indigenous labour. Furthermore, the production processes used were for the manufacture of standardized and very low-value-added products, which meant that cost minimization was decisive for these firms in their survival bid. Some directors also argued that using more skilled labour and less unskilled labour led to reductions in the costs of production due to gains in productivity and less time spent on manufacturing the products.

Cost minimization was not viewed as a motive for adapting the imported technology by only one subsidiary. The director explained that costs of labour was already relatively high when they established their operations (1995) and their sole motive for adapting their technologies was to avoid a shortage of skilled labour which would have seriously jeopardized their supply operations.

A very similar pattern was also observed for the joint venture sample. There was a widespread agreement that decisions to adapt imported technologies were driven by cost and quality considerations and also to ensure a reliable flow of output. These factors were deemed very important given the market orientation of these firms.

However, there were certain companies whose decisions to adapt their home production processes were not guided by the above-mentioned objectives. Cost reduction, for example, was not critical for five firms when they chose to modify their technologies; four directors did not adapt their technologies to ensure a continuous flow of output while two firms did adapt their production techniques for reasons other than meeting quality standards.

There was an added reason which motivated firms of both categories to adapt their imported technologies. Many directors reasoned that one of their main priorities was to ensure that products were made to buyers' specificities and such situations led to firms having, on various occasions, to adapt their production processes accordingly. Furthermore, some of the buyers were supplying their own materials to the zone's manufacturers which meant that the technologies used had to be modified to accommodate the raw materials provided.

### **Upgrading of the Production Techniques Used by the Subsidiaries and Joint Ventures in the Mauritian Zone Since their Date of Establishment.**

With the advent of the World Trade Organisation and increased liberalization of world trade, firms operating in developing countries are facing increased competition. No longer can they rely on preferential trade agreements which

guarantee an export quantum. Their future survival will very much depend upon how competitive they are in this new era of trade liberalization.

Furthermore, the mushrooming of low-cost labour centers, manufacturing low-value-added standardized textiles products, has entailed that the future success of developing countries' firms reside in producing higher-value-added products which prioritise qualitative rather than quantitative and cost considerations. In this respect, investing in more sophisticated and advanced technologies and production processes may be the key to future growth/survival.

Table 3 depicts the types of changes made to the production techniques used by the foreign subsidiaries and joint ventures operating in the Mauritian zone, since their date of establishment.

**Table 3. Types of Changes in Production Technologies Since Date of Establishment**

	FO Sample		JV Sample	
	Yes	No	Yes	No
More Labour Intensive	1	29	3	33
More Capital Intensive	23	7	24	12
More Reliant on Skilled Labour	17	13	18	18
Less Reliant on Skilled Labour	1	29	6	30
More Reliant on New Techniques from MNE Group	15	15	14	22
Embody Locally Originated Production Techniques	1	29	3	33
Different Because of Changes in Production Mix	13	17	17	19
Better Adapted to Local Inputs	0	30	2	34

The results show that twenty-six subsidiaries (approx. 90%) and twenty-eight foreign joint ventures (approx. 78%) have changed their production techniques since their initial date of establishment.

The evidence clearly demonstrates that there has been a general upgrading of the technologies used by both sets of firms. For the subsidiaries' sample, twenty-three directors argued that their production techniques are more capital intensive; sixteen reasoned that their techniques are more dependent on skilled labour; thirteen directors indicate that their technologies have changed because of changes in their product mix, which in most cases are more to up market ones; and, finally, fifteen

others said that they changed their technologies to accommodate the demands and technologies transfer policies of their parent companies.

Nevertheless, the most frequent response by the directors was that their technologies are nowadays more capital intensive. This is not surprising especially in view of the increased global competition and the loss of labour costs as a source of competitive advantage. Furthermore, the gains in productivity from using more automated and sophisticated production processes should not be underestimated.

What transpires more fundamentally is the fact that the Mauritian zone has been the recipient of capital-intensive and sophisticated technologies and not just labour intensive machineries which suited the local factor endowments. There is the recognition from all sides of the importance of producing more up-market and higher-value-added products.

The benefits from such general upgrading of technologies are enormous. Firstly, the transfer of new and more sophisticated technologies demands a retraining of the labour force which entails the diffusion of skills by the foreign firms. Secondly, there might be the diffusion of both technologies and skills when workers leave the multinationals to take up employment in indigenous firms. Thirdly, such general technological upgrading is also indicative of a shift in the competitiveness strategies of these firms from that of low-cost producers to high-quality textile and garments manufacturers. It also highlights some level of embeddedness<sup>7</sup> by these firms which may serve to highlight the strength of the zone.

Closely related to the use of more capital-intensive techniques is a greater reliance on skilled labour by the foreign companies. In this respect, the provision of training by the subsidiaries themselves is very fundamental<sup>8</sup>. However, the expected participation by the local authorities in providing the appropriate training to better equip the indigenous labour is equally very important. Hence, training institutions such as the Mauritian Employees Federation and the Industrial and Vocational Training Board should be able to provide appropriate training programmes to ensure that there is no scarcity of skilled labour.

The results also demonstrate a greater reliance by the subsidiaries on the transfer of new techniques from the parent companies for a general upgrading of their technical capabilities. This highlights the very limited innovative capabilities of the local subsidiaries. But, after all, in most cases, these subsidiaries are specialised and networked product supply subsidiaries and to find the contrary would have indeed been very surprising.

Nevertheless, such transfers involve, in almost all cases, more capital intensive and sophisticated technologies, which only reinforces the view of an increased predisposition by the multinationals to shift their strategic orientations to higher-value-added products. Such a situation can only be beneficial to all parties involved.

Such shifts to more capital-intensive techniques may also be explained by the changes that have occurred in the product mix of these companies. There are thirteen cases whereby companies have changed their production techniques as a direct consequence of changes in their product lines. The quest for greater competitiveness has led to firms shifting their production mix from standardized to high-quality and high-value-added products which in most cases require more capital intensive and automated modes of operations.

Very similar patterns could also be discerned for the international joint ventures. The directors also argued that their technologies are more capital intensive (24) and that they are more reliant on a skilled labour force (18). Their main reasons were for gains in productivity and to be more competitive. There was also widespread agreement (17 cases) that their production techniques have evolved as a direct consequence of changes in their product mix which are more sophisticated. Finally, as with the subsidiaries' sample, the joint ventures have benefited from the transfers of new technologies and production techniques made by their parent companies.

The only major difference between the two samples is that the scale of innovation by the multinational firms is much greater. This is nevertheless to be expected in view of the larger sizes of the multinational firms. Furthermore, there were cases

where the joint ventures' directors argued that they were unable to upgrade their production technologies due to limitation of funds<sup>9</sup>.

On the other hand, one multinational director reasoned that the production technique used by his company is more labour intensive nowadays than it originally was. The director nevertheless argued that the company's operations (established in the mid 1990s) and profitability were now being seriously undermined by the lack or unavailability of a skilled pool of labour. The technological base was too capital intensive and using more labour-intensive production techniques at least ensured a reliable flow of output.

The very same reasoning was given by the directors of three joint ventures in their bid to explain the move to labour-intensive techniques after their dates of establishment. There was, however, an additional motive for choosing less capital-intensive technologies. One of the directors believed that their choice was directly linked to a change in their product mix which required greater manual dexterity.

The change in techniques to use less skilled labour may be viewed as directly related to choosing more labour-intensive techniques. A direct relationship was depicted between the single multinational's choice for opting for more labour intensive techniques and a greater reliance on less skilled and hence cheaper labour.

With regards to the joint venture sample, there were six companies which opted for production techniques which were less dependent on a pool of skilled labour, after their date of establishment. Again, as with the foreign subsidiaries, such a situation was as a direct consequence of the decision to choose more labour-intensive techniques. Some of the directors also argued that they were able to replace their skilled labour with new technologies and machines which were able to perform the required tasks as efficiently and even more efficiently in certain cases<sup>10</sup>.

There were also a few cases where the underlying motives for changing the production techniques were to embody locally-originated production techniques. Such reasoning could be discerned for two joint ventures and one foreign

subsidiary. This very importantly denotes the presence of some innovatory capabilities (though very limited) in the Mauritian zone. The directors postulated that their products are designed by indigenous personnel and hence their choices of the appropriate technologies were made accordingly.

Finally, two joint ventures' directors believed that they changed their production techniques to ensure that they were better adapted to the local inputs which were being used in the manufacturing process. They argued that such alterations were unavoidable in view of the substantial changes in their product mix and given that their clients, which were also firms operating in the Mauritan zone, were supplying their own raw materials. On the other hand, no such motive for changing the original production techniques, could be depicted for fully-owned subsidiaries.

### **Local Technology Standard Compared to Group General Standard**

There is a general belief that the technology used by the parent companies and subsidiaries, originating and/or operating in developed countries, are predominantly capital intensive in nature, in response to the factor endowments present in those nations.

The directors of both sets of companies were also asked to compare the level of technology used in their Mauritian operations to the general standard used within their respective group. The evidence, it is hoped, would be indicative of the technological capabilities of the zone's firms but, more importantly, it would provide very significant insights into the long-term strategic orientations of these firms.

As previously stated, the substantial investment in the upgrading of production technologies does provide reassuring signals as to the level of embeddedness of the foreign firms in the local zone, which is very important for the long-term competitiveness and future survival of the zone.

Tables 4 depicts the standard of technology used by foreign subsidiaries and joint ventures, operating in the Mauritian zone, in comparison to the general standard which is being used in the groups' other subsidiaries and parent companies.

**Table 4. Level of Tech. Used Compared to the General Standard Within the Group**

	FO Sample			JV Sample		
	Yes	No	N/A	Yes	No	N/A
More Capital Intensive	10	15	5	7	22	7
More Labour Intensive	12	13	5	13	16	7
More Use of Skilled Labour	7	18	5	8	21	7
Less Use of Skilled Labour	9	16	5	10	19	7

The data shows that the technologies used by both samples of firms are more labour intensive in comparison to the general standard used elsewhere in the group. This is, however, hardly surprising in view of the fact that the technology transferred is very much reflective of the host country's factor endowments. Hence, given that the Mauritian zone offers a relatively large pool of labour, the relatively labour intensive nature of the production processes transferred is to be expected.

Twelve multinationals' directors reasoned that the technologies used in the Mauritian zone are more labour intensive. They, nevertheless, argued that their technology bases are much stronger and they employ more skilled labour than they were previously doing at their dates of establishment. Very similar arguments were given by the thirteen joint ventures' directors in their bid to explain the comparatively labour-intensive nature of their manufacturing processes.

Closely related to the above is the issue that such relatively more labour-intensive technologies may require a lesser use of a skilled labour force. The findings do confirm the presence of such a trend. The technologies used by nine foreign subsidiaries and ten joint ventures were deemed to require less use of skilled labour than those required by their sisters' or parent companies' production technologies. But some of the directors of these companies were quick to highlight that their current production technologies do demand a greater skilled labour participation than what was originally required at their dates of establishment.

More importantly, however, the data shows that ten multinationals' and seven joint ventures' directors rated the technologies they were using to be higher than the general standard being used elsewhere in their groups. Some directors argued that their Mauritian subsidiaries were the recipient of the latest technologies and that they could even in some instances boast to have superior and more sophisticated production processes than those used in developed countries.

Such findings only serve to confirm the view that there have been substantial efforts made by a number of firms to upgrade their technologies, which is an indispensable element for their future survival. This can only bode for a very bright future for the Mauritian zone. Such evidence is also testimony to the increased determination by firms to upgrade their product lines in their struggle for greater competitiveness.

The use of such sophisticated technologies inevitably requires a highly-skilled labour force. In this light, seven subsidiaries and eight joint ventures operating in the Mauritian zone, deemed that their technologies required greater use of skilled labour. The benefits ensuing from the transfer of such high-level technologies may be great given that these foreign firms also have to dispense the appropriate training which can only lead to a general upgrading of the indigenous zone's skills.

### **The Level of Technology Used by Foreign Subsidiaries and Joint Ventures Compared to Indigenous Firms**

An additional way of measuring the level of technological adaptation and diffusion by multinational firms and foreign joint ventures is to compare their levels of technologies with those of indigenous firms. In this light, the directors of both sets of companies were asked to compare their levels of technologies with those used by comparable indigenous firms in terms of size. The findings are depicted in Table 5.

**Table 5 Level of Technology Used Compared to Indigenous Firms**

	FO Sample		JV Sample	
	Yes	No	Yes	No
More Capital Intensive	11	19	9	27
More Labour Intensive	7	23	20	16
More Use of Skilled Labour	12	18	11	25
Less Use of Skilled Labour	7	23	13	23
Stronger in Terms of Basic Technology	13	17	9	27
Less Well Adapted to Local Inputs	0	30	0	36

However, the evidence produced mixed results for both samples of firms. While, for the foreign-owned subsidiaries, the evidence tends to suggest that they are more capital intensive (less than 50% however), yet the joint ventures tend to exhibit lower capital intensities. The data shows that eleven multinationals' directors view their technologies to be more capital intensive than those used by their local counterparts.

Such results were hardly surprising given that these firms originate from more developed nations. Furthermore, the fact that some of these multinationals' directors argued that they possessed very sophisticated technologies and that they were far superior to those which were being used elsewhere in the group may be a very plausible explanation of such higher capital intensity.

However, there were also seven subsidiaries which viewed their technologies as being of more labour-intensive nature than those used by indigenous firms. Some of the directors argued that, despite substantial investment in new production processes, they were still lagging behind local firms.

This may only serve to highlight the significant investment in new technology undertaken by some of the local firms. But the role played by foreign subsidiaries, including those which are now lagging behind in terms of technological capabilities, should not be underestimated. Many local firms have been known to imitate the production processes used by the foreign subsidiaries and also there are various instances where local staff have left the multinational enterprises to set up their own firms.

Thirteen subsidiaries' directors also reasoned that their basic technologies were stronger than those of local firms. The evidence tends to support the premise that there is a direct relationship between the technological base of a country's firms and its level of development. More importantly, however, such a trend of stronger technological base was very pronounced for firms established in the zone in the late 1980s and 1990s.

This is a very interesting and important finding in that it demarcates the Mauritian zone from other low-cost producing nations by way of its ability to attract relatively higher capital-intensive production entities. It also highlights the shift in the strategic orientation of the local zone from a low-cost producing area to one which produces relatively higher-value-added products. The very sound technological capabilities of indigenous firms also operating in the zone may only serve to confirm the above inference.

The evidence gathered for the fully-owned sample also shows that their technologies demand greater use of a skilled pool of labour. Thus, twelve subsidiaries' directors believe that their technologies are more skill intensive. But, again, this was expected in view of the very high degrees of sophistication of the technologies used by some of these firms.

On the other hand, seven foreign subsidiaries' directors regarded their technological processes as being less skill intensive. Here the most frequent explanation given by their directors was related to the substantial progress achieved by competing indigenous firms. Furthermore, some did argue that the use of less skill-intensive processes was directly related to the types of products manufactured which rendered any comparison very difficult.

With regards to the joint venture sample, the main finding was that the majority of directors (20) viewed their technological processes to be more labour intensive and less skill intensive (13) than those used by their local counterparts. Their main reasoning pertained once again to the substantial technological investment and progress made by the local firms over the years. Some of the directors even argued

that they were unable to compete with the local firms given the consequent technological gap that has been created and also due to limitation of funds<sup>11</sup>.

The joint venture directors also believed that local firms are much stronger in terms of basic technology (only nine viewed the opposite) and capital intensity (again only nine did not agree). Furthermore, only 11 JVs perceived their technological processes to be more skill intensive than those of the local firms. Finally, none of the joint ventures and foreign subsidiaries viewed their production techniques to be less well adapted to local inputs or raw materials used.

However, effective comparison proved very difficult because finding matched pairs of foreign and local firms both in terms of size and types of products proved very difficult. Additionally, the production processes used by some of the foreign firms were only motivated by the necessity to meet their buyers' product specificities and such instances complicated matters further.

As an end note, it would have been more appropriate if the actual capital intensities of individual firms, both local and foreign, were calculated. Unfortunately, due to data limitations and the unwillingness by the directors to disclose such information, only qualitative inferences were feasible.

## **Conclusion**

A host country stands to benefit more if it is the recipient of production technologies which suit its local factor endowments. The more appropriate the technology, the greater the technology diffusion gains and the employment benefits for the host country.

The evidence suggests that the majority of foreign subsidiaries and joint ventures adapted their imported technologies in some way or another. Surprisingly, the main type of adaptation undertaken by both categories of firms was for using a less unskilled labour pool. This may sound very counterintuitive given the availability of a large pool of educated but unskilled labour in the early years of the zone.

But this might also be a sound explanation to the ongoing presence of these firms in the local zone given that cheap labour is no longer viewed as a competitive advantage for Mauritius. Furthermore, and more as expected, there were some firms which modified their imported production processes to take advantage of a large pool of cheap and unskilled labour.

There were also some companies which did not adapt their technologies for reasons of quality and meeting buyers' product specificities. In this respect and more interestingly, for the joint venture sample, there were indications of a 'country of origin effect' whereby more Asian firms adapted less (or did not adapt at all) their production technologies.

Nevertheless, there was an overwhelming consensus among the directors with regards to the motives underlying the adaptations of imported technologies. Cost and quality considerations were important motives governing the adaptation processes of these firms. Additionally, ensuring a reliable flow of output and meeting buyers' product specificities were also very important criteria.

The data also shows that all the joint ventures have upgraded their technological capital intensity since their dates of establishment. Also all the subsidiaries, barring one firm, have done the same, but to a greater extent. The results highlight the commitment of a number of these firms to continuously improve upon their production processes which are vital for their future growth and success, even more so in view of the advent of the World Trade Organisation and the emergence of competing low-cost centres.

On the other hand, the majority of directors for both sets of companies reasoned that their technological capabilities are lower when compared to those used elsewhere within their groups. Such a pattern was to be expected in light of the positive relationship between a country's technological base and its stage of development. However, there were certain firms which exhibited a very high degree of technological sophistication, even higher than their developed countries' sisters companies. This situation may serve to highlight the degree of

embeddedness of some of these foreign entities and this can only bode well for the future of the Mauritian zone.

Finally, there was a distinct belief among both sets of directors that indigenous firms' technological bases were often comparable, and even outweighed in some instances their in-house production technologies. Such trend was nevertheless more pronounced for the joint venture sample, given their relatively smaller size and limited financial capabilities. But the technological investment and progress achieved by the local firms should, by no means, be underestimated.

### *Notes*

<sup>1</sup> See for example Wang and Blomstrom (1992); Findlay (1978); Blomstrom and Persson (1983); Globerman (1979); and Caves (1974). See also Kokko (1992) for an in-depth review of the benefits.

<sup>2</sup> See for example Wells (1993).

<sup>3</sup> See for example Reuber (1973); Lall (1979); Helleiner (1975) for cases where multinationals significantly adapted their imported technologies.

<sup>4</sup> Technology selection and adaptation tend to be related since in many industries there may be a tendency to select the technologies that are most easily adaptable.

<sup>5</sup> The term country of origin effect is used to determine whether the samples that did not adapt their technologies were mainly developing countries' multinationals.

<sup>6</sup> Failure to do so may lead to buyers shifting their orders to other sites very similar to those of the Mauritian zone.

<sup>7</sup> This is even more important given the footloose nature of low cost producing companies.

<sup>8</sup> The multinationals do provide the required training as confirmed by other evidence in the survey.

<sup>9</sup> Some directors believe that the Mauritian Government should be more flexible and ready to provide the necessary financial assistance to those companies who wish to upgrade their technologies.

<sup>10</sup> This was done to ensure that the firms did not suffer from a scarcity of skilled labour.

<sup>11</sup> Most of the joint ventures are small to medium sized firms.

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