Job and Skill Impacts of New Technology in the East Asian Electronics Industry

Findings from Recent Literature and Annotated Bibliography

RICHARD HEEKS and ANNE SLAMEN-McCANN

This paper reviews recent (post-1985) research literature on job and skill impacts associated with new manufacturing technologies and more globalised production in the East Asian electronics export industry. It describes the unique developmental, technological and cultural framework of the industry, as a result of which it is successfully managing the assimilation of new technology. Employment levels are not falling in the face of automation, while the main problem remains labour shortage. Imported technology has been effectively absorbed and technological capabilities have been accumulated, up to levels of globally-competitive innovation in the most successful cases. There is a fresh round of international division of labour in which East Asia emerges as a new 'core' and second-tier Asian nations as a new 'periphery'. Government has played an important role but national tri-partite mechanisms need to be fostered, in particular to address the rapidly emerging issue of continuous training and retraining.

1. Introduction

Like other innovations before it, the recent wave of microelectronics-based technology has wrought many changes in the world. Although many of the changes have been similar to those associated with previous 'new' technologies, four features of microelectronics:

- pervasiveness
- high speed of continual technical change
- increasing convergence and integration
- flexibility and adaptability

have led its effects to be more wide-reaching than those of earlier technological waves.

Simultaneous with the diffusion of this new technology - and very much related - has been the globalisation of international manufacturing by which inputs, processing and sales are sourced from/in various different locations. One aspect of this globalisation has been an international division of labour in which labour-intensive, relatively low-skill elements of the production process have been located in cheap labour, developing country sites whilst high-skill functions such as research and development (R&D), design and global co-ordination were retained in the industrially-developed countries (IDCs).

This paper presents findings from a review of recent research on the implications of new microelectronics-based production technology within one globalised industry: the electronics industry of the four East Asian newly industrialising countries (EA.NICs - Hong Kong, Singapore, South Korea and Taiwan). This was chosen not merely because of the industry's global significance (with output levels of more than US$1 trillion), but also because of its importance to industrial output, employment and exports in the EA.NICs.

Whilst clear differences between these countries emerge, there are also commonalities that include the significance of electronics production to all the economies, especially exports, and an

initial reliance in building the industry on foreign investment, on foreign infusions of technology, and on low local wages.

Given these commonalities, various unhappy scenarios present themselves in relation to the continuing innovation of process technologies. Jobs may be lost as automation increases; jobs and income may be lost as production is relocated if wages rise or market proximity outweighs labour costs as a factor in production decisions; and skills may be lost as automation leads to deskilling.

This paper therefore presents findings of a review of the available literature to see if such scenarios are likely and to answer the basic question: 'What are the job and skill impacts associated with new manufacturing technologies and more globalised production for the East Asian electronics export industry?'.

1.1. Data Caveat

The traditional complaint that there has been too little research in this area remains true. Only a small handful of studies were found that relate specifically to the stated topic. Much of the evidence presented here has therefore had to be drawn from parts of other work, but even this is insufficient.

Figures on diffusion of new manufacturing technologies are lacking, for example. It remains unclear how new the technologies in use are, how effectively they are being used and, quite simply, to what extent they are being used. On the basis of the little evidence there is, all one can assume is a trend of increasing use and increasingly effective use of increasingly up-to-date electronics manufacturing technology.

Even worse, hardly any usable data was found to assist investigation of the technology-skills relationship. With scant agreement on skills measurements, and small sample sizes, the little research that has been done provided only very limited pointers.

Even basic definitions create problems. Definitions and categorisations of 'employment' and 'unemployment' differ between the NICs, as does the definition of 'electronics industry'. Trends may therefore be clear within individual countries, but comparisons between countries and absolute figures are not. As noted below in the 'Future Research' section, there is also a lack of clarity about the meaning of labour shortages.

Any investigation into the impacts associated with microelectronics production technology runs into three recurring problems when analysing past research. Firstly, it can be hard to disentangle product and process technologies. Process innovations enable production of new types of products which will themselves have impacts. Some studies take this linkage into account; others ignore it.

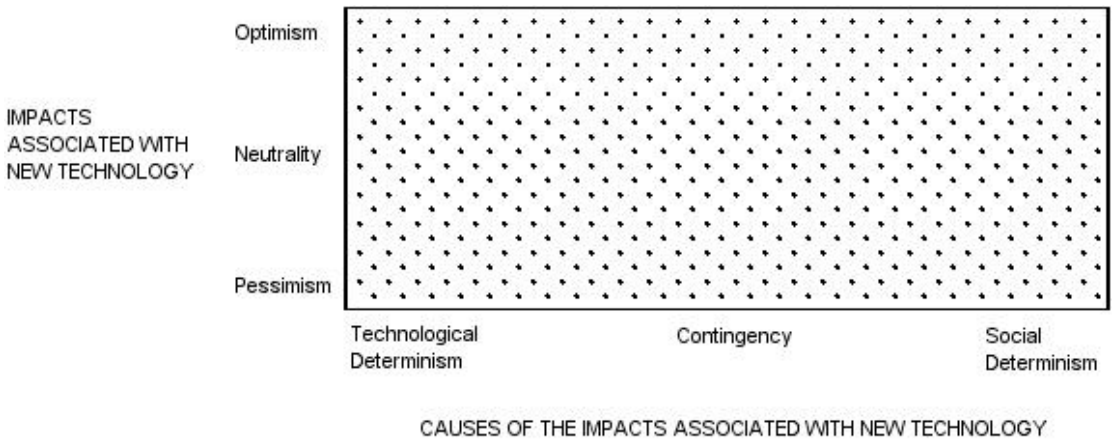
Secondly, as described in detail by Kaplinsky (1987), level of analysis varies greatly and this affects the technology-impact relationship. What, for example, may appear to be a clear labour-saving/displacing effect of technology at the level of a manufacturing process may disappear from view if looked at from a sectoral, national or global perspective.

Thirdly, research work may appear at almost any point within the impacts-causes diagram shown in Figure 1, depending on the different beliefs and theoretical perspectives used by the

researchers involved. Some writers are optimistic that new technology brings benefits, whilst pessimists see mainly negative impacts. Along the other dimension, technological determinists will ascribe the main weight of impact to the equipment and little to the organisational and social setting, whilst social determinists see the technology itself as being of relatively little importance in its relation to job and skill impacts.

Figure 1

Viewpoints in the Literature on Impacts Associated with New Technology



In fact, much of the work reviewed recognises the importance of the social context in mediating the relationship between technology and job/skill impacts, and three aspects of the social context have been highlighted:

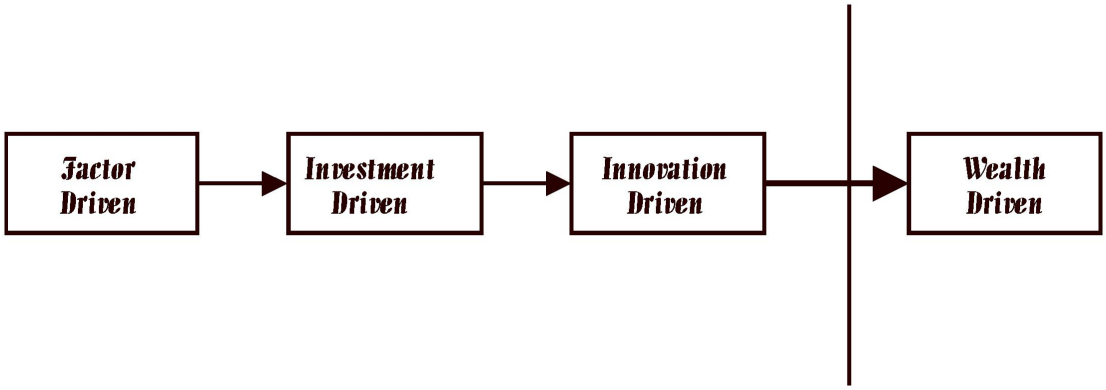
- Managerial strategies. A contrast can be made between a stereotypical IDC strategy of introducing technology to reduce labour costs and a stereotypical EA.NIC strategy of introducing technology to access new markets.
- Government policy. Some Asian governments have strongly encouraged compensation for labour displacement associated with certain new technologies by assisting training and, hence, job creation.
- Overriding these first two aspects, there are national cultural factors - 'the Confucian ethic' - that affect the impact of technology.

Finally, the EA.NICs have in this paper, as so often in the past, been lumped together for reasons of clarity and simplicity. It is, of course, recognised that their differences are many. In terms of firm type, foreign investors dominate in Singapore; small local entrepreneurs are most common in Taiwan and Hong Kong; whilst in South Korea the chaebol conglomerates take by far the largest share of production. In terms of industrial development, analysis of Porter's model (see Figure 2) and work (Porter 1990, Fitzgerald 1994, Porter 1994) would suggest that Singapore still relies heavily on its labour pool as a basic factor of production; Korea is increasingly focused on investment in its well-developed local industries; while Hong Kong and Taiwan lie somewhere between the two.

Thus, for example, while one can talk about an Asian model in the descriptive sense, it would be a mistake to try to extrapolate this very far for prescriptive purposes. Whilst there are similarities between the EA.NICs, the differentiation between countries and even within the industry is great. For these and the other reasons outlined, the conclusions drawn here must be marked with a large caveat.

Figure 2

The Competitive Development of National Economies



Source: Porter (1994:7)

2. Summary of Findings from Literature Review

Compared to the IDCs, the EA.NICs began, some years ago, as 'second-tier' nations. They were therefore faced with attempting a technological 'catch up'.

Current data indicates that - in the most successful instances - the electronics industries of the EA.NICs can be said to have 'caught up'. They have channelled imported technology in both its hard and soft forms (i.e. both equipment and related capabilities and organisational mechanisms) into technological development for substantial exports; their process technologies are similar to those used in the IDCs; they have indigenous R&D work producing process innovations; and they themselves are at the core of some international divisions of labour.

Not all firms have reached this point, though, and it is worth reviewing the stages through which a 'typical' firm may pass. These are outlined below, but three points are worth making first:

a) This trajectory is so generalised and the experience of real firms so differentiated that it does not represent any individual firm's experience.

b) This is a historical view. Firms today neither can nor should necessarily follow the same path.

c) Hobday's (1995) cautious optimism should be borne in mind here. Not all the EA.NICs' electronics firms have followed the successful trajectories outlined below. Some have failed,

some have not grown, and others remain in a weak position with only weak R&D capabilities, uncertainty over future employment growth, and a position in the international division of labour that - whilst not totally peripheral - cannot be said to represent a new core either.

2.1. Technology and Skills

1. Initial Stage

Highest local skills: low, e.g. choosing between imported technologies, and simple assembly.

The firm is almost entirely dependent on imported technology and foreign high-level skills. The process technology is often not of the latest generation, and the firm relies on 'experts' from the transnationals to transfer skills. Products are already mature in IDC terms (i.e. at the end of the normal product life-cycle), are simple and offer low value-added. Firms are relatively information-poor receivers of technology.

2. Growth Stage

Highest local skills: developing, e.g. reverse engineering and technology adaptation.

The firm still needs fresh infusions of imported technologies, but its technological dependency is declining as it internalises the technological capabilities embodied within the imports. It is an increasingly proactive, educated, confident global 'shopper', able to pick and choose suppliers and able to negotiate agreements that maximise technological absorption and learning. Process technology and the organisation of production are growing in complexity.

3. Maturation Stage

Highest local skills: high, e.g. process innovation through R&D. (Of course, this does not mean that the firm has only high-skilled workers, since there will be a range from low- to high-skilled employees, with signs of skill polarisation though also (see next section) of relocation of some lower-level skills to other Asian sites.)

The firm now has growing independence (or, at least, interdependence) rather than dependence on TNCs. It uses the latest technology sourced both internally and externally. External sourcing occurs not merely through purchase of technology directly, but also by investments in foreign firms to gain access to their ideas and innovations. Production increasingly organised on an international basis. Complex products and high value-added.

Throughout, the best firms have retained a constant commitment to training and to learning, with clear strategies for raising their level. Other aspects conducive to the rise in technological capability include agreed goals across government and industry in regard to technological development and, within this:

- extensive development of education and training institutions,
- strong government support for R&D,
- a high value placed on education within the EA.NICs,
- a greater feeling of responsibility for employee development than found in the West.

With the possible exception of Hong Kong, the national technology infrastructure of the EA.NICs is strongly in place and gaining in global recognition. It supports further expansion of the electronics industry, ensures ongoing skill changes and presents a structure to support positive technology and skills management.

2.2. Technology and Jobs

1. Initial Stage

Firms use new technology to break into new export markets, therefore creating rather than destroying jobs.

2. Growth Stage

Technology is again used to foster expansion, diversification, and increased product quality. The result is increased output, increased exports, an increasing number of jobs and higher wages.

3. Maturation Stage

Only now does the picture change somewhat, as new technology is being used partly in order to overcome labour shortages. There is still no decrease in jobs though there may be a danger of future potential jobs being suppressed.

With firms in the EA.NICs still at a whole variety of positions in this developmental continuum, the overall picture has altered from one of growing employment to labour shortage in all skill areas. Various strategies are adopted to overcome this. These include importing foreign labour; encouraging migrants to return home; using other incentives to encourage women to join the labour force; and relocation of production to other countries with surplus labour. As noted above, automation is also being used.

Overall, then, there has, as yet, been no clear evidence, at organisational level and above, of employment diminishing in the EA.NICs' electronics industries through use of new manufacturing technologies. Even where automation has created labour displacement, continuing increases in investment and output have more than compensated. Government actions have helped and so, too, have managerial strategies.

In the IDCs, research has shown evidence for job losses associated with new manufacturing technologies from the level of individual processes up to the national level. The EA.NICs have been different. Many reasons can be cited, but clearly the managerial strategies and intentions behind introduction are key. The strong Western emphasis on technology for labour-saving contrasts with the use of new technology by many EA.NICs' electronics firms to improve product quality or break into new markets. This 'catch-up' strategy has thus involved using technology differently to typical 'leader' strategies.

2.3. Globalisation

1. Initial Stage

Some foreign investment comes, seeking out cheap labour. Jobs fall clearly within the new international division of labour, with R&D, design and coordination retained in the IDC core, leaving only lower-skilled work in the EA.NICs.

2. Growth Stage

The EA.NICs remain attractive to foreign investment because of the increasingly skilled workforce, the growing industrial infrastructure, and continuing government incentives.

Through concentration and specialisation of skills in low as well as high-tech fields, the EA.NICs' firms become regional centres of excellence in particular activities, such as testing or R&D. What foreign investment there is comes to seek these high-level skills rather than a low-skill, low-paid labour pool, though some see this as a continuation of past practice in the relocation of production activities from costly IDCs to still-cheaper-despite-wage-rises EA.NICs.

Proximity to a growing EA.NIC domestic market also attracts foreign investors.

3. Maturation Stage

EA.NICs' firms themselves start to become new cores in the global electronics industry. They become transnational corporations and, particularly given the labour shortages at home, they may sub-contract labour-intensive assembly work to a new cheaper-labour site within Asia (though some low-skilled jobs still remain in the home country). Thus, a new round of international division of labour begins.

Concerns about 'footloose capital' - seeking the best location at all times and relocating whenever necessary - start to diminish. EA.NICs' firms are themselves undertaking acquisitions overseas to gain market access.

3. Future Trends

Slowly but steadily, firms in certain sectors of the EA.NICs' electronics industries seem to be emerging from a phase of catching-up to a phase of leadership. In so doing, one sees signs of Western characteristics emerging; characteristics that have been associated with electronics industry leadership. These include globally competitive R&D and use of leading-edge technology.

One might also claim to see other signs of 'Westernisation':

- An ever-decreasing gap between EA.NIC and IDC wage levels.
- Greater job mobility and a more 'bottom-line' attitude of employers towards employees.
- The use of automation to save labour.
- Attempts by firms to increase the flexibility of their workforce through measures such as replacing full-time with part-time workers, greater use of migrant labour, and sub-contracting of production to other locations.
- Changes in the political economy with less role for government and a greater role for industry (and, by implication, for market forces).

These might therefore also point to a future for the East Asian electronics industries that includes losses of jobs and competitiveness.

No-one knows what the future will bring but an educated guess would say that, in the next few years at least, these losses will not occur. From the current signs, it seems more likely that the EA.NICs' electronics industry firms will continue to grow strongly, to innovate, to export, to invest overseas, to increase the level of skills and jobs, and to remain more concerned about the needs of their workers than the 'average' Western company. The World Bank (1995:58) remains optimistic about the effect of new investments in human and technological resources - 'skill acquisition and capital deepening will translate into rapid manufacturing growth.'

As discussed below, though, much will depend on continuing to adopt intelligent organisational and governmental strategies.

One last trend is that all the East Asian electronics industries have been, and are likely to remain, significantly export-oriented. However, the countries' domestic markets are growing, especially certain consumer markets, driven on by the rising level and relative equality (compared, for example, to some Latin American economies) of incomes. There is likely to be somewhat less inequality between export- and domestic-oriented production in future. Although the attention of other transnationals will increasingly be drawn to these domestic markets, the overall outcome for production, income and jobs in the EA.NICs is only likely to be positive.

4. Organisational Strategy

There is, of course, a huge variety of different firms within the EA.NICs' electronics industries, and any conclusions will differ considerably between, say, a small Taiwanese sub-contracting firm, a South Korean chaebol, and a large Singapore-based transnational.

Nevertheless, there are some obvious strategies that have worked well for almost all firms in the past, and will continue to do so in the future. Examples are acquisition, adaptation and innovation of technology; focused R&D; training and retraining of workers; and dialogue with government.

One likely change is the increasing and different interactions with other firms. Most EA.NICs' firms have always interacted with suppliers and clients on a global scale. However, there is a clear trend for closer user-producer relationships in terms of both tighter links with customers and suppliers, and greater use of sub-contracting. A whole spectrum of stronger relations with other producers is also emerging, from acquisitions and mergers to alliances and simple 'networking'.

Of these, perhaps the most significant is the sub-contracting of some elements of production to other Asian production sites, the issues of which are summarised in the following section.

4.1. Sub-contracting as a Strategy

Firms in the EA.NICs' electronics industries sub-contract to other locations in order to gain one or more of the following benefits:

- reductions in costs or development time;
- resources freed to be redirected into strategic initiatives;
- access to new skills, ideas and technology;
- access to new market opportunities;
- greater flexibility, especially in staffing.

Strategically, the EA.NICs' firms should be, and are, seeking close relationships (i.e. with close managerial control and/or shared equity) with the sub-contractor for the following reasons:

- reduction in uncertainty about production availability, price, quality, post-sale maintenance, etc., and a desire for direct control over these factors;
- greater ease of transferring technology and skills, without losing knowledge and other intangible assets to potential competitors;
- access to sub-contractor intangible assets, such as knowledge of the local policy environment and production conditions;
- the ability to indulge in transfer pricing to avoid taxation;
- internal capture of benefits that would otherwise accrue to the sub-contractor;
- sharing of investments and risks;
- government regulations or incentives.

However, sub-contracting is by no means risk- or cost-free. Benefits do not arrive automatically, but only through careful management. Sub-contracting must therefore be well planned, with a clear strategic objective and with thought given to selecting only those elements of production which are appropriate, to true costs, to the in-house alternative, and to the impacts of sub-contracting on in-house staff.

Sub-contracting requires a strong in-house managerial capacity, with sufficient project management skills to co-ordinate and monitor it continuously during development, and with sufficient technical skills to make informed decisions.

Once a decision to sub-contract is made, it is obvious that trust and commitment to the client/sub-contractor relationship are a key to greater benefits, but that these can only come if the sub-contractor is well chosen. Various sub-contractor criteria can be evaluated, including:

- cost;
- reputation;
- past work and past client satisfaction ratings;
- outstanding litigation and bad debts;
- production quality to be provided.

Once a sub-contractor is chosen, part of building trust and reducing uncertainty for the client is good communications between all parties; a set of formal mechanisms for transfer of skills and technology (such as planned training programmes); plus good contract specification that should include:

- an unambiguous description of activities and skills required;
- details of timetable, deliverables and incentives or penalties;
- a clear set of performance measures, acceptance criteria and procedures;
- a clear set of 'Go/No Go' decision points;
- a clearly-defined dispute resolution process;
- agreement on asset transfer;
- agreement on how to change the contract, given the need for flexibility.

5. Governments and National Strategy

Although some will still only partially and grudgingly admit it (World Bank 1993; see also Wade 1994), government intervention has been an essential part of the growth in output, exports, jobs, and skills in the EA.NICs' electronics industries. With the exception of Hong Kong, government policy and action has encouraged technology import, absorption, adaptation and innovation. All of these have been fundamental to industrial growth and development.

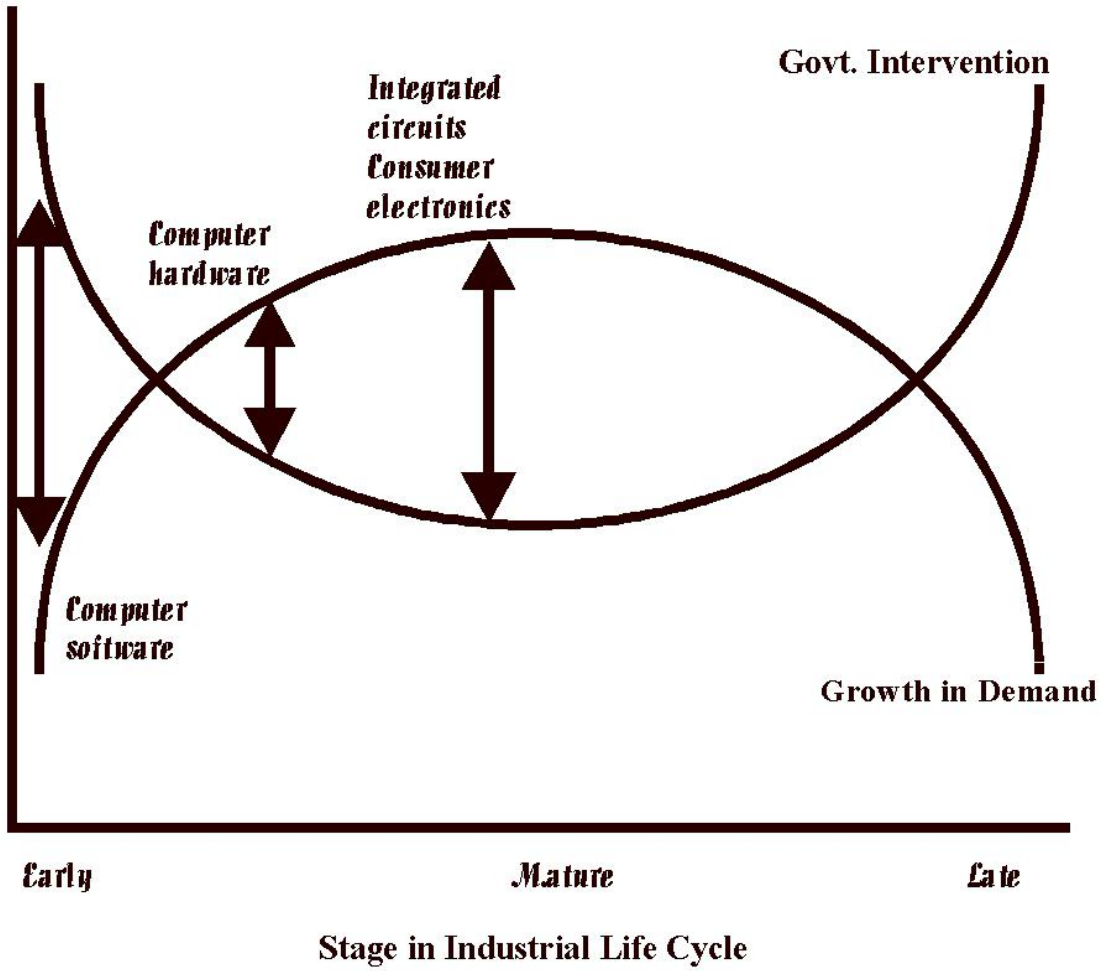
The question now is - what future role is there for strategy?

Such is the variety of technologies, organisational forms and skill requirements within the different EA.NICs and even within their individual electronics industries, and so limited is the current data, that drawing conclusions about government policy remains a perilous affair.

However, it can be seen that the EA.NICs' electronics industries are constantly maturing. According to a number of simple models - summarised in Figures 3 and 4 - the various electronics industry sectors lie somewhere between the infantile and mature stage at present. Whilst these sectors continue to mature (and until they reach the stage of decline in demand), then the signs point towards a declining strategic role for government and an increasing role for industrial managers and entrepreneurs. According to this logic, EA.NIC governments have helped nurture many electronics industry sectors through the infantile stage until they are sufficiently capable, confident and globalised to run on much more under their own impetus.

Figure 3

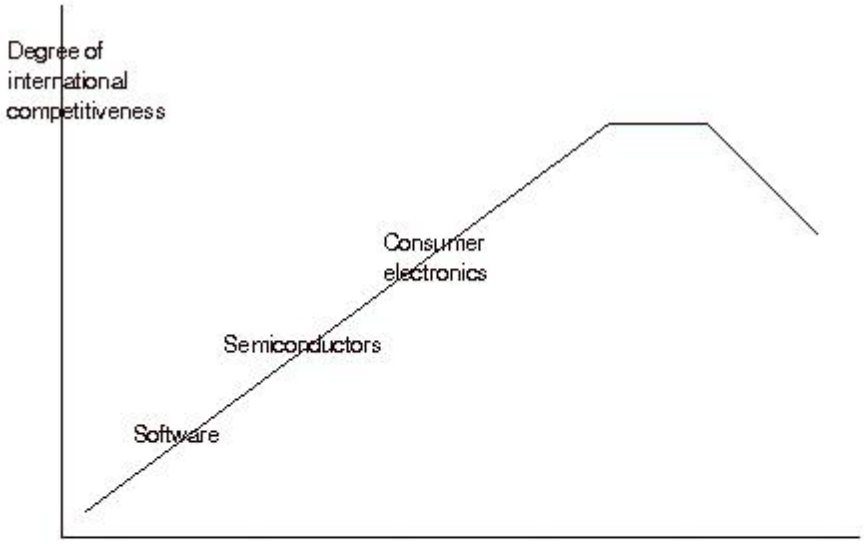
Intervention and Demand in the Electronics Industry



Source: adapted from Okimoto (1989: fig. 1.5)

Figure 4

Life Cycle of Electronics Industry Competitiveness



Stage	Infantile Stage	Growth Stage	Maturing Stage	Declining Stage
Physical Factor	Endowed Resources	Business Environment	Related & Supporting Industries	Domestic Demand
Human Factor	Workers & Politicians & Bureaucrats	Politicians & Bureaucrats & Entrepreneurs	Entrepreneurs & Professional Managers & Engineers	None

Source: adapted from Cho (1994:30)

Both models predict a declining role for government intervention in the medium term, and that government action in the future is likely to need to be different from that in the past. Nonetheless, this does not mean that the role of government will be entirely different, nor that future success is predicated on an intervention-free strategy.

Future success is still likely to be rooted - as it has in the past - in government having the right kind of foresight and long-term planning, in constantly changing policy as and when required, and in choosing the right skills to imbue. Long-term planning, particularly, should remain a hallmark of the EA.NIC governments that differentiates them from most of their IDC counterparts.

Social partnership between government, employers and employees seems essential to future success. The partnership holds prime importance for human resource development because of the need to involve industry in projecting future skills, in devising appropriate training curricula, and in devising complimentary and mutually supporting in- and out-of-house training at the appropriate time. The social partnership is needed to provide the support and also to ensure the worker has sufficient personal gain (from government and employer) to remain with an organisation that has invested in his/her training.

Yet this partnership has actually been weak in the EA.NICs since the 1950s. The governments have been the strongest players with business a distant second and the workers an even further third, if represented at all. The reasons for this involve the nature of rapid economic and

industrial development which far outstripped the rate of development of employers' and employees' organisations (ILO 1995).

Now, however, the uneven moves in the EA.NICs toward democratisation are changing the political economy of these countries. In the past decade, industry has been encouraged to take a greater responsibility in all regards in order to be competitive when the final protective barriers are taken down. Workers also have become increasingly vocal whether through the unions as in Korea or via workers' federations in Singapore.

Government dominated the partnership in the past, but if industry and workers experience greater freedom of action and greater equality within the tri-partite relationship with government, then the strategies and trajectories of the future will differ from those in the past.

The future character of the social partnership is in a formative stage as the political systems of all the EA.NICs become more democratised, as the social framework seeks a new balance of traditional and imported values, and as the globalisation of national economies changes the requirements for competitiveness.

In terms of the social partnership's influence upon the skills profile of the future it appears that the government may have relatively less power to direct and hold back worker demands for social support. If this occurs, further distortions in the labour market may produce pressures both for and against support of ongoing skills upgrading. The individual EA.NICs will each form the response to this challenge blending socio-cultural factors with ongoing technological pressures.

This will require new research, and there will also need to be a focus on the process of dialogue and policy formation, and on the infrastructural and institutional arrangements for dialogue more than on particular policy items.

Governments, for example, are not static entities but are continually changing. One suggestion has been that government serves client groups, like industrial entrepreneurs, best where its staff's background and values, and institutional structures and processes map as closely as possible to those of the client group (Gibb and Manu 1990). According to this perspective, government should be reorganising to produce a higher-skill, more open, networked organisational form.

Future success is also still likely to depend on government action to support the industrial infrastructure, local R&D, easy access to new technology, basic education and, perhaps more than anything else, training.

It is not yet clear from research on labour displacement and compensating employment growth whether it is the same workers who are moving to new jobs, or whether one set is losing their jobs and a different set gaining them. Given the greater degree of employer-employee commitment than seen in IDCs and the other factors, the former seems the more likely strategy, at least for certain types of worker.

Whatever the true answer - which only further research can uncover - it is essential that government promotes and invests in workforce training along continuous training and retraining lines, as described in the following section, which is adapted from Pang (1994).

5.1. Continuous Training and Retraining as a Strategy

A national CTR strategy should be clearly outlined in an appropriate policy statement, with three broad aims:

- raising awareness of, and demand for, CTR opportunities within the electronics industry;
- bringing CTR into the mainstream of vocational training;
- affirming the principle of lifelong training and learning.

The strategy should focus on particular target groups within the electronics industry, for example, those facing most rapid technological change, those in the key export-earning spheres, or those whose skills are becoming obsolete. The needs of older workers may also be given special attention.

The groups, and their training needs, are best identified through use of labour market analysis models specific to the electronics sector and sub-sectors rather than the more traditional national manpower requirements approach (Psacharopoulos 1991, Adams et al. 1992).

In designing the training delivery mechanisms, three key principles must be borne in mind. Firstly, training systems must be *responsive* to market needs.

Secondly, training must be *available* and *accessible* to those that need it. Barriers that demotivate individuals from seeking CTR, or discourage employers from providing such training, must be removed. Training (Green 1987:10) must be:

- Available to both employers and employees as and when they need, not when it suits the training provider to deliver.
- Provided where it suits employers and employees, be it at the work-place, at home, or at a special training location. CTR programmes should not be confined to formal institutional training courses, but should take other forms of individualised learning opportunities such as self-paced learning and distance learning.
- Relevant; that is, providing training that relates to the skills and knowledge directly usable at the work-place. The prior experience or skills and knowledge acquired by individuals must also be given due recognition. For example, experienced workers should be provided with the opportunity to progress faster towards some form of competency qualification by claiming exemption or credit through a system of 'accreditation of prior learning'.
- Provided in 'small chunks' that can be easily fitted into firm and employee work schedules.
- Supported by information, guidance and counselling services that help and encourage individuals to take advantage of the learning opportunities made available.

Thirdly, training systems must be *flexible*, in order to adapt and update themselves as new training needs arise.

All three of these principles will be influenced heavily by the institutional form where, for example, the rigidities of certain national training systems can make them inherently unresponsive and inflexible. The development of a comprehensive infrastructure of training institutions and programmes for the provision of CTR is absolutely vital, and hence should form a central concern of the national CTR strategy.

Training institutions need to provide:

- an *a la carte*-type structure of alternative training and learning opportunities, instead of a fixed schedule of training courses;
- a decentralised management system that gives the institutions the necessary decision-making autonomy and financial latitude, say, to adjust the resource allocation and course contents quickly;
- flexible support systems rather than fixed and scheduled allocation of facilities and resources.

In all this, the state will have a pivotal role. It should:

- Outline an explicit strategy, possibly as a legislative measure within a broader employment, human resource development or training framework.
- Issue directives covering training regulation and administration, for example on skill testing and qualification, occupational skill standards, or training requirements.
- Define the respective roles and responsibilities of the state vis-a-vis the industry. State actions would include provision of financial incentives to encourage more firms to undertake CTR, getting larger enterprises to extend their training programmes to non-employees as well as those requiring retraining, and introducing levy and tax measures (as a number have already done) to fund CTR programmes. The state is less likely to take on a role as a training provider except in cases of market failure, such as training for employees in small electronics enterprises which will not or cannot invest in training.
- Generally aim to promote and perpetuate a culture of lifelong training and learning amongst training practitioners, policy-makers, employers and, most of all, individuals.
- Provide a suitable mechanism to ensure that a satisfactory degree of quality assurance, uniformity and co-ordination can be achieved.

6. Future Research

Authors such as James (1985, 1993) have highlighted the dearth of research work on the EA.NICs' electronics industries. Although new work is being added all the time, this topic still remains insufficiently researched. As a result, for example, a number of the conclusions in this paper can only be hazily, rather than sharply, drawn.

All research must accept that each EA.NIC is different from all the others, and that research with a regional and homogenising perspective is distinctly limited. Policy recommendations cannot be valid if they exist in a historical and socio-cultural vacuum. Going further, it is also clear that the span of products, processes, jobs and skills is now so great within the electronics industry that even research that aggregates at the sectoral level is suspect.

In particular, then, there need to be more micro-level, in-depth studies focusing on the choice, use, adaptation and innovation of technology within individual firms. The few existing studies and the aggregated figures simply do not provide enough detail on certain key issues:

- the true extent of technology diffusion, which one suspects to be slower than imagined with new technologies sometimes supplementing rather than supplanting older generations;
- the way in which technology is being adapted and used;
- the continuing role of low-skilled jobs;
- the fate of individual workers within the overall labour market.

On this last issue, too much has also been taken for granted in use of labour-related terms such as 'flexibility', 'mobility' and 'labour shortage'. What do these mean in reality? There is too little evidence on the use of recruitment as opposed to retraining in sourcing new skills. The ability and willingness of employees (especially in certain groups) to change employers appears to be less than in the IDCs, but also appears to be increasing. How great is this mobility, and is the increase acting as a disincentive to training? What does the labour shortage really mean for the EA.NICs - a shortage of skills or a shortage of people?

The uneven moves in the EA.NICs toward democratisation are changing the political economy of these countries. If industry and workers experience greater freedom of action and greater equality within the tri-partite relationship with government, then the strategies and trajectories of the future will differ from those in the past. This will require new research, including work on attitudes to new technology and on the role of labour unions.

Research in three other areas needs bolstering:

a) Work in English on Taiwan is lacking compared to that on the other three EA.NICs. With its particular mixture of transnationals, large local firms and great numbers of small enterprises, and its uncertain relationship with mainland China, Taiwan has characteristics not found in the other NICs. The true extent of technology diffusion into the three main industrial groups needs further investigation.

b) Much of the work on these electronics industries has been 'gender-blind'. The use of women workers in export processing zone (EPZ) industries has been investigated but there are signs, for example, of more women workers being taken on in the non-EPZ industries. This can form part of strategies to overcome labour shortages as well as strategies to seek cheaper, more flexible staffing. As has been done, for example, in the case of Malaysia's globalised sub-contracting work, there needs to be more research looking at the differential impacts of particular technological trajectories and business strategies on men's and women's jobs and skills.

c) A greater attempt to move beyond stereotypes to a clearer understanding of the ways in which any 'Confucian ethic' affects the technology-employment/skills relationship within individual firms.

Finally, all the countries in the world do not follow a neat, linear, historical progression. Whilst the experience of the EA.NICs may offer lessons for other developing countries, it does not offer a definitive blueprint. As electronics industries emerge in other countries, so fresh research will need to be commissioned.

Similarly, there has been a false assumption implicit within much research to date that EA.NICs have been following a path already beaten by the IDCs. As has been shown, not only have the EA.NICs followed a path somewhat different to that of the IDCs but they can also, in one or two instances, be seen as 'ahead of the game' compared to the IDCs. Perhaps it may therefore be time for research that seeks to draw lessons for IDCs from the experience of the EA.NICs rather than vice versa - as has so often been the case in the past.

Annotated Bibliography on Technology, Employment and Skills

With Particular Reference to the East Asian Electronics Industry

Adams, A.V. et al., 1992, 'Market-based Manpower Planning With Labour Market Signals', *International Labour Review*, vol.131, no.3, pp.261-280.

Reviews the changing role of manpower planning in globalising and increasingly market-oriented economies.

Amjad, Rashid and Mohanty, Mritiunjoy, 1991, *Industrial Restructuring and Implications for Human Resource Development in ASEAN*. (New Delhi: International Labour Office).

Provides an overview of HRD strategies in the region, with no specific focus on electronics.

Amsden, Alice H., 1989, *Asia's Next Giant: South Korea and Late Industrialization*. (New York: Oxford University Press).

Comprehensive review of South Korean development, including analysis of the role of government intervention.

Amsden, Alice H., 1994, 'Why Isn't the Whole World Experimenting with the East Asian Model to Develop?: Review of *The East Asian Miracle*', *World Development*, vol.22, no.4, pp.627-633.

Critical review moves emphasis to government interventions, subsidised learning for competitiveness and more research to study how elements of the East Asian model can be adapted to suit conditions in other countries.

Asian Development Bank, 1989, *Asian Development Outlook 1989*. (Manila: Asian Development Bank).

'The Development of Human Capital' chapter offers a detailed analysis with statistics including education and health for the whole of Asia . Figures now old; Outlook with summary of EA.NICs' economies is printed every year with a single, specialist focus chapter.

Braverman, H., 1974, *Labor and Monopoly Capital*. (New York: Monthly Review Press).

Neo-Marxist analysis of the relationship between capital and labour, mainly as mediated through the use of new technology.

Cantwell, J., 1995, 'The Globalisation of Technology: What Remains of the Product Cycle Model?', *Manchester Business School seminar*, University of Manchester, UK, March 1st 1995.

Also an article in Cambridge Journal of Economics. Reviews registered patents and deduces trends of innovation & R&D. Globalisation of R&D is now the norm, and strengthens through specialisation (grouping of expertise) of the national systems of innovation.

Castells, Manuel, 1989, 'High Technology and the New International Division of Labour', *Labour and Society*, vol.14, Special Issue on High Tech and Labour, pp.7-42.

Focus on internationalisation and interdependence of global economy and microelectronics-based technological revolution. Statistics cover all manufacturing for all NICs up to 1984 relating technology development with globalisation, competitiveness, rapid export-led growth, and technology transfer. Globalisation defined in core/periphery terms. Conclusions frame

policy for developing countries to gain access to technology for modernisation, e.g. via regional networks.

Chen, Tain-Jy, 1992, 'Technical Change and Technical Adaptation of Multinational Firms: The Case of Taiwan's Electronics Industry', *Economic Development and Cultural Change*, vol.40, no.4, pp.867-881.

Rather narrow focus - TNCs and pre-1982 data. Sees competitive pressures of exports forcing firms to reduce skill- and capital-intensities.

Chiu, Stephen and Levin, David A., 1993, 'From a Labour-Surplus to a Labour-Scarce Economy: Challenges to Human Resource Management in Hong Kong', *The International Journal of Human Resource Management*, vol.4, no.1, pp.159-189.

Views Hong Kong's HRM in the context of its current labour shortage and the impending return to Chinese rule. Sees an increasing need for government intervention in training and retraining.

Cho, D.-S., 1994, 'A Dynamic Approach to International Competitiveness: The Case of Korea', *Journal of Far Eastern Business*, vol.1, no.1, pp.17-36.

Interprets Michael Porter's work in the Korean context, choosing semiconductors as one of four focus industries.

Chow, Peter C.Y., 1990, 'Output Effect, Technology Change, and Labor Absorption in Taiwan, 1952-1986', *Economic Development and Cultural Change*, vol.39/1, pp.75-88.

Takes an econometric perspective on the Taiwan labour market to map the structural changes and the conflicting forces of both capital-substitution for labour and continuing economic expansion.

Dahlman, C.J. et al., 1985, *Managing Technological Development: Lessons from the Newly Industrialising Countries* (World Bank Staff Working Paper no.717). (Washington, D.C.: The World Bank).

Reviews NICs' experience to conclude that integration into global technological capabilities is more important than technological self-sufficiency.

Dekker, W., 1986, 'Managing a Global Electronics Company in Tomorrow's World', *Long Range Planning*, vol.19, no.2, pp.31-37.

Reviews strategies for TNC electronics firms in the light of global trends.

Dicken, Peter, 1992, *Global Shift: The Internationalization of Economic Activity* (2nd edn.) (London: Paul Chapman).

Describes general background and theoretical underpinnings of globalisation, including issues of NIDL. Focus on issues such as product life-cycle and emphasises technological change is not deterministic, but that choice drives technology. Includes case study of the electronics industry.

Ebel, Karl-H., 1989, 'Manning the Unmanned Factory', *International Labour Review*, vol.128, no.5, pp.535-551.

Takes a number of perspectives on CIM - roots of innovation; relationship with employment; drivers behind introduction. Tries to look beyond the hype at the real - and perhaps slow and limited - likely impacts of the technology.

Ebel, Karl-H., 1991, 'Computer-Integrated Manufacturing: A New Menace for Developing Countries', *International Labour Review*, vol.130, nos.5-6, pp.635-644.

Examines the nature, diffusion and future of CIM with reference to LDCs. Concludes that LDCs require a technological infrastructure before CIM becomes useful. Feels it is premature to project future diffusion and impact trends.

Ebel, Karl-H. and Ulrich, Erhard, 1987, 'Some Workplace Effects of CAD and CAM', *International Labour Review*, vol.126, no.3, pp.351-370.

Reviews the impacts that have been associated with CAD/CAM - both quantitative (jobs) and qualitative (skills, working environment, industrial relations). Reinforces the importance of taking a social perspective on new technologies.

The Economist, 1993a, 'Survey of the Computer Industry: Reboot System and Start Again', *The Economist* (London edn.), February 27th 1993, pp.S3-5.

The global shake-up in the computer industry continues with rapid change, innovation and mergers/acquisitions.

The Economist, 1993b, 'Survey of Asia: Why it Happened', *The Economist* (London edn.), October 30th 1993, pp.S7-10.

EA.NIC-specific analysis of economic growth as a product of human resource development through labour profile, education and link to productivity.

The Economist, 1994, 'Taiwan's Computer Industry: Inside the Box', *The Economist* (London edn.), July 9th 1994, pp.83-84.

Computer industry as highly competitive and hinging upon R&D and management structure. Includes some 1993 statistics. Takes a particular focus on Acer.

The Economist, 1995a, 'South Korea Survey: Quick, Quick, Quick', *The Economist* (London edn.), June 3rd 1995, pp.S3-5.

Focus on the political and economic changes underway in South Korea.

The Economist, 1995b, 'Putting a Value on People', *The Economist* (London edn.), June 24th 1995, p.105.

Focus on the difficulty of measuring human capital as an important source of economic growth.

Edgren, G., 1990, 'Employment Adjustment and the Unions: Case Studies of Enterprises in Asia', *International Labour Review*, vol.129, no.5, pp.629-648.

India and ASEAN focus with some EA.NIC references. Examines why some countries have been able to create more jobs during industrialisation rather than lose them, and implications for future roles of unions, labour profile, and women's role in industry. Topics covered include protection of employment and incomes, flexibility of workforce (retraining) and technological change. Concludes with call for more research and more tripartite (worker-employer-government) interaction to support change.

EIU, 1994a, *Hong Kong, Macau Country Profile 1994/95*. (London: Economist Intelligence Unit).

EIU, 1994b, *Hong Kong, Macau Country Report 4th Quarter 1994*. (London: Economist Intelligence Unit).

EIU, 1994c, *Singapore Country Profile 1994/95*. (London: Economist Intelligence Unit).

EIU, 1994d, *Singapore Country Report 4th Quarter 1994*. (London: Economist Intelligence Unit).

EIU, 1994e, *South Korea, North Korea Country Profile 1994/95*. (London: Economist Intelligence Unit).

EIU, 1994f, *South Korea, North Korea Country Report 4th Quarter 1994*. (London: Economist Intelligence Unit).

EIU, 1994g, *Taiwan Country Profile 1994/95*. (London: Economist Intelligence Unit).

EIU, 1994h, *Taiwan Country Report 4th Quarter 1994*. (London: Economist Intelligence Unit).

EIU reports overall provide clear economic and business perspective on particular nations. Includes history and background in annual profiles. Significant data, trends and qualifications are reported with currently available detailed statistics, and predictions. Detailed analysis for all EA.NICs. Electronics industry details reported only when 'newsworthy'.

FEER, 1994, 'Review 200', *Far Eastern Economic Review*, December 29th 1994/January 5th 1995, pp.64-69.

Ranks top companies nationally for overall leadership, product/service quality, innovation, long-term vision and financial soundness. Electronics industry currently represented in most lists with brief reports on future company plans.

FEER, 1995a, 'The East Is Wired', *Far Eastern Economic Review*, June 15th 1995, pp.70-79.

Technology and market report on personal computer industry. Some statistics.

FEER, 1995b, *Asia 1995 Yearbook: A Review of the Events of 1994*. (Hong Kong: Far Eastern Economic Review).

Good for background of annual events influencing development and trade. Few statistics, and specific references to electronics industry are rare.

Fitzgerald, R., 1994, 'Comparisons and Explanations of National Economic Success: Analysing East Asia', *Journal of Far Eastern Business*, vol.1, no.1, pp.1-16.

Introductory article on journal issue interpreting Michael Porter's work in the context of East Asian development.

Fong, Chan Onn, 1993, 'Malaysia and Singapore', in: *Microelectronics and Third-World Industries*, S. Watanabe (ed.), pp.46-69. (London: Macmillan).

Reviews the spread of factory automation in Malaysia and Singapore. Provides data from 1980s' surveys on diffusion and impact of new process technology. No particular electronics focus.

Freeman, Chris, 1989, 'New Technology and Catching Up', *The European Journal of Development Research*, vol.1, no.1, pp.85-99.

Takes a positive view - based on EA.NIC and Japanese experience in relation to microelectronics-based technology - that some LDCs can 'catch up' in certain sectors and/or technologies.

Freeman, Chris and Hagedoorn, John, 1994, 'Catching Up or Falling Behind: Patterns in International Interfirm Technology Partnering', *World Development*, vol.22, no.4, pp.771-780.

Looks to see if the normal pattern of concentration of technological capabilities in IDCs is repeated in alliances between IDC and LDC firms. Evidence is that - by and large - the concentration is still seen except for EA.NIC firms. Not electronics-specific.

Gibb, A. and Manu, G., 1990, 'The Design of Extension and Related Support Services for Small-Scale Enterprise Development', *International Small Business Journal*, vol.8, no.3, pp.10-26.

Takes a new theoretical approach to the nature of promotional/interventionist government institutions and the match/mismatch between those institutions and the businesses they seek to serve. Provides a multi-dimensional framework on which to judge similarities and differences between the two.

Gomes, Stephen L. et al., 1991, 'Global Factors in the Successful Implementation of Technology-Driven Development Strategies', in: *Technology Companies and Global Markets*, D.V. Gibson (ed.), pp.273-289. (Savage, Maryland: Rowman & Littlefield Pub).

Describes the way in which regionalisation of high-tech activities, particularly R&D, impacts upon the global distribution of specialised areas. Emphasis on continuous learning of innovators through close physical proximity. Does not consider LDCs or NICs in design feasibility.

Government of Singapore, 1993, *Economic Survey of Singapore 1992*. (Singapore: Ministry of Trade and Industry).

Includes statistics on manufacturing, with categories for electronic products. Statistics cover establishments, employment, remuneration, output, workers and value-added over two years. Some explanation and contextualisation of industry in chapters.

Green, M., 1987, 'Open and On-going: Adapting to Training Needs', *Training and Development*, October 1987, p.10.

Brief discussion of the changing training/retraining environment and requirements.

Henderson, Jeffrey, 1989, *The Globalisation of High Technology Production: Society, Space and Semiconductors in the Restructuring of the Modern World*. (London: Routledge).

Key text with specific focus on almost all aspects of the global electronics industry.

Hobday, Mike, 1991, 'Semiconductor Technology and the Newly Industrializing Countries: The Diffusion of ASICs (Application Specific Integrated Circuits)', *World Development*, vol.19, no.4, pp.375-397.

Detailed examination of ASICs - the technology and its implications. ASICs allow the detachment of the design function and a new opportunity for electronics innovators if the skills are available. Emphasises that if the opportunity is not taken up loss of competitiveness may result. Explores possible policy responses at international and EA.NIC national levels.

Hobday, Mike, 1992, 'The European Electronics Industry: Technology and Structural Change', *Technovation*, vol.12, no.2, pp.75-97.

Comprehensive examination of trends in the European electronics industry.

Hobday, Mike, 1994a, 'Export-Led Technology Development in the Four Dragons: The Case of Electronics', *Development and Change*, vol.25, pp.333-361.

Key work, focusing on the development of technological capabilities in the EA.NICs' electronics industries. Includes model of latecomer strategies, overviews of the four industries plus a couple of specific company case studies.

Hobday, Mike, 1994b, 'Technological Learning in Singapore: A Test Case of Leapfrogging', *The Journal of Development Studies*, vol.30, no.3, pp. 831-858.

Discussion of 'leapfrogging' in electronics for technological development. Concludes that learning is gradual and incremental. Industrial development in electronics involves a gradual and systematic accumulation of industrial, educational and infrastructural capabilities. Singapore electronics industry discussed in historical perspective. Industry statistics to 1991.

Hobday, Mike, 1995, 'East Asian Latecomer Firms: Learning the Technology of Electronics', *World Development*, vol.23, no.7, pp.1171-1193.

Updated and modified version of 1994a paper.

Hoffman, Kurt, 1985, 'Microelectronics, International Competition and Development Strategies: The Unavoidable Issues', *World Development*, vol. 13, no.3, pp.263-272.

Introduction to special issue with same title.

ILO, 1988, *Technological Change, Work Organisation and Pay: Lessons from Asia*. (Geneva: International Labour Office).

Provides background concepts and some case studies and profiles of electronics companies discussing history and attitudes to labour, technology and training.

ILO, 1992a, *Strengthening Technological Capabilities: A Challenge for the Nineties: A Review of ILO Activities on Technology* (Third edition). (Geneva: International Labour Office).

Part of an ongoing series that regularly summarises ILO work on technology, technological capabilities, employment and working conditions impacts, training and industrial relations issues.

ILO, 1992b, *World Labour Report 1992*. (Geneva: International Labour Office).

ILO, 1994, *World Labour Report 1994*. (Geneva: International Labour Office).

ILO, 1995, *World Labour Report 1995*. (Geneva: International Labour Office).

Statistical annex to annually-produced reports includes socio-economic indicators and figures on labour force and employment profile and trends, wages, industrial action and social security. Main articles of significance include some EA.NIC data: 'The World Employment Situation, Trends and Prospects' (1994); 'Ageing Societies: Problems and Prospects for Older Workers', 'Retraining and Returning to Work: An Issue That Concerns Us All' (1995).

James, Jeffrey, 1985, *The Employment and Income Distributional Impact of Microelectronics: A Prospective Analysis for the Third World* (WEP Working Paper 153). (Geneva: International Labour Office).

Provides a descriptive, theoretical and methodological framework for approaching the microelectronics technology-employment/income relationship.

James, Jeffrey, 1993, 'New Technologies, Employment and Labour Markets in Developing Countries', *Development and Change*, vol.24, pp.405-437.

Key overview work. Literature survey covers impact of new technologies, primarily microelectronics, on employment and labour markets in LDCs. Framework covers generation and diffusion of new technology and the complex multiplicity of ways in which they influence each other. Directs attention to the gaps needing further research. Indirect references to EA.NICs.

Kanawaty, George et al., 1989, 'Adjustment at the Micro Level', *International Labour Review*, vol.128, no.3, pp.269-298.

A focus on the intra-enterprise factors (technology, flexibility, ownership, and work organisation) that affect the ability of enterprises to change and develop. Some summary discussion of technology-related impacts. Largely IDC-oriented.

Kaplinsky, Raphael, 1984, *Automation: The Technology and Society*. (Harlow, UK: Longman).

Comprehensive account of the development, diffusion and impact of new technology. Main focus on new technology in design, manufacturing and office. Considers impacts on both capital and labour. Includes a chapter on developing countries.

Kaplinsky, Raphael, 1987, *Micro-electronics and Employment Revisited: A Review*. (Geneva: International Labour Office).

Definitive starting point on impacts associated with microelectronics. Includes historical and theoretical perspectives, detailed discussion of associated impacts on jobs and skills, and consideration of policy implications. Includes coverage of EA.NICs.

Kim, J.S. et al., 1994, 'Korean Manufacturing in Transition: Patterns in the Past, Current Status, and Future Challenges', *Journal of Far Eastern Business*, vol.1, no.2, pp.34-55.

Provides a historical model of manufacturing development and compares Korean firm-level strategies, based on survey data, with those in US and Japan.

Lau, Lawrence J., 1994, 'The Competitive Advantage of Taiwan', *Journal of Far Eastern Business*, vol.1, no.1, pp.90-112.

Statistical review and analysis of factors underlying Taiwanese industrial development, placed within a framework of Michael Porter's work on national competitive advantage.

Levy, Brian and Kuo, Wen-Jeng, 1991, 'The Strategic Orientations of Firms and the Performance of Korea and Taiwan in Frontier Industries: Lessons from Comparative Case Studies of Keyboard and Personal Computer Assembly', *World Development*, vol.19, no.4, pp.363-374.

Field interviews with national manufacturers in information technology on strategic orientations toward innovation and acquisition of technology. Korean firms follow assembly strategy and Taiwanese follow bootstrap strategy. Taiwanese firms develop with much risk taking but innovation looks steady. Korea depends on a few key players and outcomes look less certain.

Liang, Kuo-shu and Liang, Ching-ing Hou, 1988, 'Development Policy Formation and Future Policy Priorities in the Republic of China', *Economic Development and Cultural Change*, vol.36/3, Supplement, pp.S67-101.

Taiwan policy formation in historical perspective with some comparison with Korea. Covers export drive, technology transfer, and government interventions deemed necessary for international competitiveness. Significant emphasis upon lack of natural resources, strength in human resources, and Confucian tradition.

Liemt, Gijsbert van, 1988, *Bridging the Gap: Four Newly Industrialising Countries and the Changing International Division of Labour*. (Geneva: International Labour Office).

Lim, Linda and Pang Eng Fong, 1986, *Trade, Employment and Industrialisation in Singapore*. (Geneva: International Labour Office).

Detailed study of Singapore up to early 1980s. Includes economic history, development objectives and outcomes, labour markets, role of government, and a specific study on electronics.

Line, Richard, 1990, *The International Electronics Industry*. (London: Economist Intelligence Unit).

Provides an economic and business perspective on the industry in detail with historical and detailed statistics, trends with explanations, future goals and predictions. Detailed analysis of South Korea, Taiwan and Japan with references to other NICs. Profiles of specific companies appended.

McDermott, Michael and Young, Stephen, 1989, *South Korea's Industry: New Directions in World Markets*. (London: The Economist Intelligence Unit).

Specific chapter on the electronics industry. Economic and business perspective of industry in detail with historical and detailed statistics, trends with explanations, future goals and predictions and strategic analysis. Statistics run up to 1987-88 with some detailed breakdowns for import/export and sections of the electronics industry.

Michell, Tony, 1983, *The Republic of Korea: Employment, Industrialization and Trade*. (Geneva: International Labour Office).

Early analysis of South Korean industry including electronics, details of government legislation, and detailed statistics and projections.

Mine, Manabu, 1986, 'The Social Impact of Micro-electronics in Japan', *International Labour Review*, vol.125, no.4, pp.473-497.

Detailed coverage of microelectronics diffusion (both factory and office), associated effects on employment, skills, task allocation and working conditions. Covers implications for training, wage levels and industrial relations. Obvious analogies with EA.NIC situation.

Muqtada, M. and Hildeman, A. (eds.), 1993, *Labour Markets and Human Resource Planning in Asia: Perspectives and Evidence*. (Geneva: International Labour Office).

Nakamoto, M., 1994, 'Technology: Helping to Ease the Daily Grind', *The Financial Times*, August 9th 1994, p.12.

Description of Toyota's human-centred approach to the use of robots on the assembly line.

New Internationalist, 1995, 'Asian Tigers - The Facts', *New Internationalist*, January 1995, pp.18-19.

Two page profile with statistics linking economic development and negative labour impact.

Ng Sek-Hong, 1987, 'Training Problems and Challenges in a Newly Industrialising Economy: The Case of Hong Kong', *International Labour Review*, vol.126, no.4, pp.467-478.

Government and private sector activity in training in Hong Kong. Main focus on enterprise-level factors that determine training responses.

O'Connor, D., 1989, *Microelectronics-based Innovations: Strategic Implications for Selected Industries in the Second-Tier Newly Industrializing Countries of Southeast Asia*. (Paris: OECD Development Centre).

Cited in James (1993).

Okimoto, D.I., 1989, *Between MITI and the Market: Japanese Industrial Policy for High Technology*. (Stanford, CA.: Stanford University Press).

Cited in Dicken (1992).

Oman, Charles, 1994, *Globalisation and Regionalisation: The Challenge for Developing Countries*. (Paris: OECD).

Concise report on the historical emergence of regional blocs, including Pacific Asia and the rise of the EA.NICs. Includes discussion of their potential future role in a globalised economy as labour costs diminish in importance and regional markets increase.

Page, John M., 1994, '*The East Asian Miracle*: An Introduction', *World Development*, vol.22, no.4, pp.615-625.

Introduction to set of articles providing critical analysis of the 1993 World Bank report.

Pang, Chau L., 1994, *Continuing Training and Retraining: The Real Training Answers in a Rapidly Changing Technological Environment?* MSc Thesis, University of Manchester, UK.

Review of technological trends in industry and necessary changes to current training approaches and policies.

Pang, Eng Fong and Lim, Linda Y.C., 1989, 'High Tech and Labour in the Asian NICs', *Labour and Society*, vol.14, Special Issue on High Tech and Labour, pp.43-58.

Key review article on use of new technologies within the EA.NICs, and the associated impacts on their labour markets and labour. Covers brief consideration of many issues including jobs, skills, wages, labour sources, industrial relations and government actions. Generally very positive about diffusion and impact of high technology in East Asia.

Park, Se-Il, 1988, 'Labor Issues in Korea's Future', *World Development*, vol.16, no.1, pp.99-119.

Focuses on four key future issues for the Korean labour market - labour pool that is ageing, more educated and with more women; rising skills demands; rising labour costs and changing remuneration systems; more democratic, participative industrial relations. No specific focus on electronics.

Porter, M.E., 1990, *The Competitive Advantage of Nations*. (Free Press: New York).

Wide-ranging work that attempts to create a relatively simply, inclusive model and explanation for national-level competitive advantage in an increasingly interdependent world. Mainly IDC-focused but includes specific consideration of East Asia.

Porter, M.E., 1994, 'The Competitive Advantages of Far Eastern Business: A Response', *Journal of Far Eastern Business*, vol.1, no.2, pp.1-12.

Summary of some key ideas and response to papers on East Asia and Porter's ideas in previous journal issue.

Psacharopoulos, G., 1991, 'From Manpower Planning to Labour Market Analysis', *International Labour Review*, vol.130, no.4, pp.459-474.

Reviews criticisms of manpower planning and offers alternative approaches based on labour market statistical analysis.

Pyo, Hak K., 1993, 'The Republic of Korea', in: *Microelectronics and Third-World Industries*, S. Watanabe (ed.), pp.92-114. (London: Macmillan).

Reviews the spread of factory automation in South Korea. Provides data from 1980s' surveys on diffusion and impact of new process technology. Includes consideration of production of automation equipment within Korea.

Rada, Juan F., 1982, *The Impact of Microelectronics*. (Geneva: International Labour Office).

Comprehensive review of microelectronics-based technologies, their diffusion and associated impacts on jobs, service and industrial sectors, and developing countries.

Rowe, C., 1990, *People and Chips*. (Oxford: Blackwell Scientific).

Comprehensive review of the literature and theory on microelectronics technology and its associated impacts on employment and skills. Includes chapter on factory automation. No real LDC/NICs focus.

Singh, Ajit, 1994, 'Global Economic Changes, Skills and International Competitiveness', *International Labour Review*, vol.133, no.2, pp.167-183.

Condensed review of developing country industrialisation, including consideration of issues of skills, globalisation, competitiveness and national systems for technological accumulation and capabilities.

Wade, R., 1994, '*The World Bank and the Art of Paradigm Maintenance: 'The East Asian Miracle' as a Response to Japan's Attempts to Change the Rules of the International Economy*'. Paper presented at 1994 UK Development Studies Association conference, University of Lancaster, UK, 7-9 September 1994.

Detailed 'behind-the-scenes' explanation of the politicking underlying the creation and content of the World Bank's 1993 report, and Japanese pressure to force admission from the Bank of the positive role of government intervention.

Wakasugi, Ryuhei, 1991, 'Technological Innovation and Diffusion in Japanese and Asian Newly Industrialized Economies', in: *Technology Companies and Global Markets*, D.V. Gibson (ed.), pp.61-73. (Savage, Maryland: Rowman & Littlefield Pub).

Details on history, level and organisation of Japanese R&D, and way in which EA.NICs and then ASEAN nations are following a similar pattern.

Watanabe, Susumu, 1986, 'Labour-Saving Versus Work-Amplifying Effects of Micro-Electronics', *International Labour Review*, vol.125, no.3, pp.243-259.

Review of technology-related employment impacts. Detailed rebuttal of the 'new technologies lead to job losses' argument.

Watanabe, Susumu, 1993, 'Microelectronics and Third-World Industries: An Overview', in: *Microelectronics and Third-World Industries*, S. Watanabe (ed.), pp.136-177. (London: Macmillan).

Summary of research on factory automation in developing countries: extent and examples of diffusion; determinants of diffusion at macro- and micro-level; employment and capability 'catch-up' issues; role of simultaneous organisational change.

World Bank, 1993, *The East Asian Miracle: Economic Growth and Public Policy*. (Washington, D.C.: World Bank).

Report emphasising that rapid industrial growth with equity is built upon human capital, openness to foreign technology and export strategy. Seen as a watershed publication from the Bank, because it finally included a (small) admission that government intervention, and not just market forces, had played a significant role in East Asian development.

World Bank, 1995, *World Development Report 1995*. (Washington, D.C.: World Bank).

Most recent in annual series of reports on the state of world development. Includes large annex of wide-ranging, country-level statistics.

Yip, Vincent F.S., 1991, 'The Asian Challenge: A Singapore Perspective', in: *Technology Companies and Global Markets*, D.V. Gibson (ed.), pp.87-101. (Savage, Maryland: Rowman & Littlefield Pub).

Discussion of technology-push versus market-pull theories of technology diffusion, choice of infrastructure, and tools of technology transfer (R&D, education, culture). Some statistics. Sees challenge for future to stay competitive whilst maintaining political stability and social well-being.