dpp

DEVELOPMENT POLICY AND PRACTICE

THE OPEN UNIVERSITY

dpp

DEVELOPMENT
POLICY AND
PRACTICE

THE OPEN UNIVERSITY

From Regulation to Promotion:
The State's Changing but Continuing Role
in Software Production and Export

by
Richard Heeks

DPP Working Paper No 30

Development Policy and Practice Research Group

Faculty of Technology
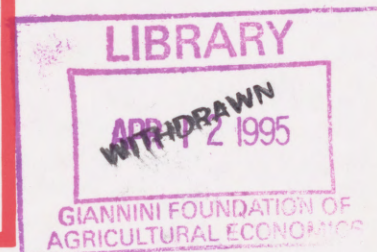
The Open University

January 1995

From Regulation to Promotion:
The State's Changing but Continuing Role
in Software Production and Export

by
Richard Heeks

DPP Working Paper No 30

Contents   **Page**

From Regulation to Promotion: The State's Changing but Continuing Role in Software Production and Export

Dr Richard Heeks[1]

Abstract

The software industry is of vital importance to economic development in developing countries, and it requires active state policy to assist its growth. Policy based on state regulation and ownership is now out of favour, but it is equally clear that market-oriented policies are not appropriate. This paper reviews successful promotional state interventions from around the world. These interventions provide inputs such as finance, training, innovation, infrastructure and market information which are necessary to any software industry. From this it is clear that states should not shift under ideological pressure from regulation to market liberalism but under pragmatic pressure from regulation to promotion. Where this is possible given external constraints, the nature of structures, skills and attitudes within the state will also need to change. By following these guidelines, governments will be in a position to foster the long-term development of their software industries and exports.

1   Software Industries and Government Policy

> "Computer software has become the 'lifeblood' of business, industry, and government." (World Bank 1993)

As a result of its crucial role in all areas of the economy, the global market for software and related services has grown rapidly. Typical growth rates have been 15-20% per year and market size is predicted to reach US$300-400bn by 1995 (Schware 1992).

The software industry[2] has been dominated by the United States, but other countries are also becoming important players - including the developing countries[3]. Not only have the developing countries been producing large amounts of software for local

---

1   The findings presented here form part of an ongoing research project, initiated in 1987, into the development of software industries in developing countries. They are drawn from fieldwork in China, India and Singapore, and from the references listed at the end of the paper. The author can be contacted to discuss this paper: Richard.Heeks@man.ac.uk

2   In this paper, the term "software industry" is used to describe those companies or company divisions which earn the majority of their revenue from sales of software consultancy services or software packages. Other sources of software, such as in-house production, will not be the focus, although governments can also act to promote this type of production - for example, through policy on research & development, training and spread of best practice.

3   Share of world software revenue outside the US, Western Europe and Japan is likely to grow from less than 10% to roughly 16% between 1985-1995 (World Bank 1993).

consumption, but exports have also grown rapidly to more than US$500m annually during the early 1990s (Heeks 1993)[4].

Because of the importance of software for local use and for exports:

> "Software production is nowadays an industry, essential for the growth of the economies of the developing countries; and the launching of programmes to promote strong and indigenous software industries is a priority task." (Fialkowski 1990)

Many other commentators - UNIDO (1983), Kopetz (1984), Narasimhan (1984), Schware (1987), Gaio (1989), Mody (1989) - agree that the creation and implementation of a government software policy is an essential element in software industry development:

> "The point of departure if a country regards software as an area of growth is the government's commitment to nurture and create the necessary conditions." (Borrego 1992)

These comments are borne out by the experiences of individual countries[5]. Where government policy has been absent - as, for example, in most Arab countries, in Paraguay, or in Turkey - piracy and imports dominate, there are few software firms, and development of the industry is severely constrained. The conclusion drawn is that:

> "Specific measures within a coherent policy framework will be required to accelerate the development of the software industry." (World Bank 1993)

On the other hand, where governments introduce the right kind of policy, successful development has ensued. The software industry in Ireland is largely the creation of the Irish government's Industrial Development Authority. In China, "...the Chinese software industry has achieved a substantial expansion under a period of increasing official support in the 1980s." (Baark 1990). In Taiwan, "...government efforts to promote an indigenous hardware and software industry resulted in 100 software houses..." (Fialkowski 1990)[6].

So, government policy for the software industry is essential, but what constitutes "the right kind of policy"?

In the 1970s and early 1980s, very few countries had a software industry policy. One of the few that did was India, which has the Third World's longest-standing software

---

4   Wagstyl (1993) rather optimistically estimates the export figure to be just under US$2bn.
5   To avoid unnecessary repetition, all references to individual countries are cited in a separate section of the references at the end of this paper.
6   Such state action is not restricted to developing countries: "To a significant extent the United States, Japanese and French governments have strengthened their software industries by a variety of measures" (Schware 1989).

2

industry policy and largest export industry. Policy at that time was framed largely in structuralist terms[7] - with laws, rules, tariffs, licences and other physical bureaucratic mechanisms as the main policy instruments, all of which form elements of "state regulation".

In those countries with structuralist software policies, initial protection and regulation often played a vital role in nurturing early development of companies and capabilities. Unfortunately, regulation was also associated with tolerance of inefficiency and encouragement of rent-seeking behaviour. These negative aspects have been the focus of attention much more often than the beneficial effects of regulation, and have led to a reaction against regulation in software industry development.

Such a reaction mirrors wider changes, there having been a pronounced crisis of faith in the structuralist policy model for the past fifteen or more years. This model - which dominated much political thinking on economic affairs since the 1930s - came under intense pressure on a number of fronts:

- pressure from multinationals and international institutions, all of which favoured market-led rather than state-led solutions to economic problems;

- pressure of self-interest within local political economies from those who now saw more to be gained from market than from state;

- pressure from supposed failures of state regulation such as recession in Western nations, declining growth rates in some developing countries, and the political demise of state socialism in Eastern Europe;

- pressure from supposed successes of the market in countries where the state had been "rolled back";

- pressure from technological changes which placed an increasing part of economic activity outside the control of state regulatory measures.

As a result, the ideological pendulum has swung away from prescriptions based around state regulation and towards prescriptions based on market mechanisms. Swings in software policy from state to market have therefore been visible in many developing countries, such as China, India, Brazil and Singapore. The new market model has been held to provide the much-desired "answer" to development but its glitter has blinded many to the evidence of the problems thrown up by market forces.

---

7   Structuralism is a political ideology which favours state regulation and ownership, trade protection and other measures to contain what it regards as the shortcomings of existing global economic structures, including markets.

Such problems are painfully evident in software industry development with even the World Bank (1993), normally a staunch supporter of market-oriented, neo-liberal policy, declaring:

> "Free-rider problems, externalities and market imperfections are rampant in the software industry. ... [Some] market-based responses only provide partial solutions to the underlying economic problems, and may even be counter-productive with respect to generation of externalities for the economy as a whole."

Others go further. Correa (1990a) states that market barriers hamper the software industry, while Fialkowski (1990) identifies market imperfections as the main constraint to software industry growth in developing countries. Both conclude that state intervention is required in order to overcome these problems.

However, in many developing countries, external neo-liberal pressures remain strong and political time lags mean that evidence about the shortcomings of market-oriented strategies has yet to be widely recognised. Developing countries, then, are still in danger of "throwing the baby out with the bath water" and abandoning almost all forms of state intervention in their bid to emulate the neo-liberal model.

This is ironic given signs in the past year or so that the ideological pendulum has slowed, possibly stopped, and may be even be swinging back very slightly in some places, beginning in the former high citadels of the market. In the US, the Clinton administration - despite the reversals of the mid-term elections - is pledged to spend more on a more active government role in industrial development, and even in the UK the Minister for Trade and Industry can promise without blushing in his inaugural speech to intervene in British industrial development. At the moment, such pronouncements indicate more a change of mood and attitude rather than action but they mean that it is timely to re-evaluate the state's role.

Evidence on policy directions for software industry development remains confused, with trends in different directions and evidence both for and against particular standpoints. Adding to the confusion is the fact that many of the countries which seem to be moving from state to market in general terms are simultaneously increasing the extent of state intervention. As well as in the US, this trend is particularly seen in Asia and to a lesser degree in Latin America. State interventions are addressing an increasing number of areas, including finance, education, marketing and improving the nature of the software production process.

In an effort to sort through these confusion's and contradictions, and to answer the question "What is the right kind of policy?", the next section reviews why and how

states have intervened in a number of areas to assist the development of local software industries.

2 State Intervention in Software Industry Development

A Finance/Investment

In some ways, software firms are not like other industrial enterprises. Their main product is intangible and of highly variable value depending on context. Partly because of the hit-and-miss nature of package sales, all software development has come to be viewed as risky and, given the conservatism of finance markets in developing countries, there has been a significant shortage of both investment and working capital[8].

States have reacted to this problem in different ways. Some have focused on attracting funds from multinationals rather than mobilising local capital. This is particularly so for smaller countries without a major domestic market to attract the foreign companies. IBM investment was attracted to Taiwan through a government-supported local institution; the Irish government has worked hard to attract foreign investment which has created more than 7000 software jobs; and Hungary provides tax holidays for software joint ventures[9].

Concerned that such investment may create little long-term benefit for the local economy, other states have focused more on local capital markets. In Brazil, the nationalised banks pushed ahead with substantial investments in software, despite its intangibility, and this has reaped rewards in terms of skills and products created. Similarly, India has used nationalised financial institutions to channel millions of dollars provided on lines of credit from overseas. The money has been used for venture and working capital funding to smaller companies that would otherwise have had to rely on self-financing. Ireland, too, has recognised these finance elements by providing working and venture capital grants and loans. Others, such as Israel and Taiwan, have used tax breaks on software company investment.

These and a number of other states have acted successfully to stimulate the supply of foreign investment and local capital into the software industry, overcoming the reluctance of chief executives and financiers alike. Where governments have not acted, as in Turkey, lack of access to capital remains a major developmental barrier.

---

8   Typical developing country software firms require US$1000-10,000 per capita start-up investment and US$500-5000 per capita per year working capital (Heeks 1995).

9   Even in the UK - that fount of market ideology - state institutions have intervened hard to attract software companies to Wales and Scotland (Computing 1993).

B   *Education and Training*

There has been widespread agreement that the single most important input to the software production process is skilled labour, but equally that the relative lack of such skilled labour is the most serious constraint to software industry development in many countries (Kopetz 1984, Schware 1990, Platz 1992).

As was the case with financing and investment, the state often finds itself working alongside private provision which has many shortcomings. While the private sector may appear very active in training, "there is little control over the quality standards of these institutions, and a good proportion of the students receive little hands-on experience in the use of computers." (Schware 1987).

In India and Singapore, governments have acted on this problem with a programme to establish skills standards through examination and certification. Singapore's government has gone further in creating three training institutes in collaboration with multinationals from different countries. Thanks to these institutes and other government measures described here, Singapore's software skills base grew more than ten-fold during the 1980s.

Governments also need to stimulate in-house, on-the-job training which forms a substantial route for skills formation. Many software companies have taken short-term views and shied away from investment in training, partly because of the dangers of staff turnover. Because they can take a more macroeconomic perspective, governments can more readily justify this type of investment. In Japan and Ireland, the state has provided grants or tax reductions for in-house training, and in Singapore 70% of the cost of continuing education for software developers has been met from public funds.

Although it needs to work alongside other provisioners, which may focus on specific skills, the state remains the prime source of core informatics skills relevant to software industry development. State education in computer science and related subjects has therefore long been recognised as an essential prerequisite for software industry growth (UNIDO 1983).

In Latin America, universities have played a major part in the development of software industry capabilities, while in Ireland an integral part of the government's software development plan was the strengthening of university computer science programmes. Complementing this, states can also seek - as did Singapore - to infuse new ideas and skills by funding training and education overseas.

Two final successful measures can be seen from Singapore. As in many countries, the state has realised the importance of general computer literacy and has pushed this into as many school and college courses as possible. Like India, it has also funded a number of very public information technology (IT) projects that have raised IT awareness. Lastly, governments can efficiently monitor labour market trends in the software industry (such as the trend away from programmers towards analyst-designers) and disseminate this information to universities, private training institutes and software firms.

C   *Research and Development (R&D)*

Direct public investment in software R&D can be justified in two main areas. Firstly, in areas such as basic software research where there are considerable economies of scale. Secondly, in areas such as software development to meet local needs, where the market has failed to produce the required products. In either case, government funding of R&D becomes more rather than less critical during periods of liberalisation - particularly in order to combat the growing impact of multinationals and the increasing concentration of innovation within their hands.

Only a few of the richer developing countries - Brazil, India, South Korea, Taiwan - have the resources to fund basic software research[10]. The Brazilian government has been particularly active, helping to focus R&D activities on areas, such as Unix and software development methodology, with rich potential spin-offs for the software industry. Many more countries invest to meet local needs. In China, for example, the government has invested heavily in the development of Chinese language software, with the added advantage that this can be used for export as well as for meeting domestic market needs.

Naturally, R&D work alone is not sufficient for industrial development - government must ensure that there are adequate channels for the dissemination and commercialisation of the innovations produced. One method has been for government to pay for the work to be done in existing private sector firms. However, where these lack the requisite skills or where the returns on investment need to be more widely accessible, the work can be done by public sector bodies. Overall, then, R&D programmes will need to follow the South Korean model, with the government directing research and development work in a mix of government, industrial and academic institutions.

---

10   The governments of Europe, Japan and the US have all invested billions of US dollars in this area in what they see as a necessary effort to assist their domestic industries by developing skills and technological innovations.

The work of successful software producers is highly R&D-intensive. Without a sufficient level of R&D, software firms will miss opportunities to develop local technological capabilities or new software products, and will be consigned to services work of low skill-intensity. Yet, just as they have tended to skimp on training, software firms in developing countries also tend to cut corners on research and development. This arises partly from short-term managerial strategies and low profitability. For example, Indian software firms spend only 3% of sales on R&D, compared to a figure of 15% in the US. Apart from directly funding software company R&D, the state can mitigate this situation by providing tax relief on R&D spending.

D   *Marketing and Provision of Market Information*

Even the largest of developing country software producers - firms like Tata Consultancy Services in India, and the Stone Corporation in China - are small by comparison with players in the West. For these (and even more for the smaller producers), market-related costs, especially in relation to foreign markets, represent a considerable barrier to growth. The costs of marketing packages and services are high, sometimes forming the major part of total costs for a package. So too are the costs of obtaining market information on potential partners, sales channels, regulations, customer needs and competitors.

States can reap the benefits of scale economies in both these areas, being of particular assistance to small and medium software enterprises, which are seen by some as the driving force of software industries in developing countries.

With regard to marketing, governments cannot directly create buyer-seller relationships, so their role is to raise general awareness and create the environment in which such relationships may begin. The Indian government has done this by organising subsidised trade exhibitions and workshops overseas, and by coordinating visits of foreign buyers or government bodies to India.

Market information can be provided on a continuous basis from government offices overseas. The Irish government has specifically opened offices around the world with information gathering as part of their remit. Information also comes on a more in-depth basis by government commissioning of market research reports which are then disseminated to software producers.

Some governments - such as those in Brazil and China - have felt it useful to set up a register of software in an effort to disseminate information which then fosters collaboration and avoids duplication of effort. However, the evidence is that many

producers avoid registration because they see no benefit, and so the registers have had little impact.

E   *Intellectual Property Rights (IPRs)*

Software piracy has more to recommend it as a strategy for developing countries than is often admitted. It has been an important, probably essential, part of the initial development of informatics in most developing countries. Piracy greatly increases the accessibility of software and so speeds the diffusion of a hardware base and the diffusion of up-to-date software. It also saves huge amounts of foreign exchange. In a related manner, weak laws on intellectual property rights allow local producers to increase growth and skills by creating versions of popular packages for the local market through "reverse functional engineering" (Heeks 1995).

Almost all commentators and all large software package producers claim that a mature local software industry requires a legal framework which only the state can provide. The framework must not only criminalise common distributional piracy, but also protect producers against the theft of their original ideas by competitors. It is said that without such legislation local producers will not invest in software package production and that the growth of the software industry will be stunted (Borrego 1992, Gwynne 1993).

Even those who posit an initial role for piracy feel that during the development of a software industry, a crossover point will be reached when the costs of lax legislation start to outweigh the benefits. Yet there has been little attempt to critically question these claims and to explain, for example, the fact that many software firms have invested in and produced packages in situations of little legislation and high piracy.

However, such questioning may be of only theoretical interest since the US government has pressurised developing countries to act on piracy long before even the hypothetical crossover point is reached. Countries threatened with retaliation - usually under the punitive section 301 of the US Trade and Tariff Act - and pushed into enacting new or tougher anti-piracy legislation during the 1980s and 1990s include South Korea, China, Taiwan, Mexico, India and Brazil. In accordance with US government pressure, most countries have taken to extending copyright law to software rather than treating software as a special case. The laws enacted are by no means the optimum legislative route, and they are more likely to benefit foreign firms rather than local ones (Correa 1990b)[11].

---

11   Indonesia has been an exception, enacting its own protection law which largely ignores software not translated into Bahasa Indonesia, or which is not publicised for the first time in Indonesia.

The orthodox view of intellectual property rights has therefore been too readily accepted and too little investigated in developing countries. There may well be only a marginal link between software industry growth and IPR legislation. Having said this, even in a marginal situation and especially in a situation of US pressure, the government retains a promotional role that cannot otherwise be fulfilled[12].

F   Infrastructure

Software producers rely on many basic items of infrastructure in order to conduct their business such as electricity, water and roads. Although these are provided by the private sector in a few Western nations, it is still generally accepted that they are provided by the state in developing countries.

There is more debate over the provision of telecommunications infrastructure. This forms a fundamental part of any strategy to move software exports away from on site "body shopping" (with its political, financial and "brain drain" costs) since overseas clients demand good phone, fax and email links before they will contract work to be done offshore (Heeks 1991b). Western companies and governments are pushing for more private sector provision of telecommunications, but autonomous state organisations in several countries have proven themselves adept at meeting software industry needs.

The Irish government's telecommunications agency has invested US2.5bn in telecommunications infrastructure to help build the software industry; South Korea's Korean Telecommunications Authority has kept revenue above expenditure whilst massively expanding international links; and in Singapore, the state has laid the foundations for it to become the "intelligent island". Even India's notorious telecommunications system now boasts good international access, used by all the top exporters and provided largely by the semi-autonomous public sector enterprise Videsh Sanchar Nigam Ltd.

Yet to be proven is the investment by some governments, such as India and Taiwan, in "software parks". These are specially-designated locations - created and sometimes administered by the state - in which several software firms are brought together. The initial aim is to reap the benefits of scale economies in infrastructural provision and of operational gains from clustering similar small firms. More ambitiously, some hope to add in government-funded training, consultancy, validation, and market research facilities.

---

12   Just as it does in creating the legislative framework for many business-related areas where "free market" behaviour is held to have a negative impact on long-term development.

There is yet to be any clear evidence of gains made from software parks. Given the problems of software technology parks in India; the absence of clear benefits for software firms working in export processing zones; and the possibly misguided nature of the spatial concept behind industrial parks, such promotional measures should obviously be approached with great caution (Wahi 1993, Heeks 1995).

Finally, some governments have attempted to alleviate the problem of low technology-intensity of software production found in many developing countries. One method has been for the state to invest in an infrastructure of hardware (especially large IBM-compatible machines) to which small software firms are given access. In both India and China such investment has had a bad record of failing to meet other than narrow academic software production needs. Such an infrastructure is also becoming outdated given falling price:power ratios, increasing portability of software development environments across hardware platforms, and increasing access to overseas computers through wide area networks.

The alternative method - used in India, Hungary, Mexico and the Philippines - has been to provide import tariff reductions on hardware used by software developers. While this has undoubtedly helped software firms, there has been a lot of "overspill" with computing power imported for software firms finding its way to other users.

Infrastructural provision has therefore been like the curate's egg: "good in parts", especially in telecommunications, but less successful in other measures.

G   Procurement

There is general agreement that a healthy domestic market is a precursor to long-term success in exports, and that the small size of domestic software markets in most developing countries is a severe constraint to industrial growth (Schware 1987, Fialkowski 1990, Press 1991, Platz 1992, Heeks 1992b). Because of its large purchasing power, the state is the most important domestic consumer for emerging software industries and is therefore in a strong position to influence the local software industry's development through its procurement policies[13].

The first stages in this process are to ensure that, throughout the public sector, software specifications are sufficiently detailed and sufficiently unbundled from hardware to allow local software firms a chance of tendering. Governments can also act to ensure

---

13   The public sector can make up more than half the domestic market, as in India. Even in Western, market-oriented economies, the state is still normally the single largest domestic customer. In the US, for example, government forms around 20% of the market (Coopers & Lybrand/IDC 1986, Gaio 1989).

that staff are sufficiently well trained to consider factors such as support and reliability as well as price in choosing software (World Bank 1993). Without these changes, contracts will often go to foreign hardware and software package suppliers. Once these changes are in place, governments can act - as in Brazil and Singapore - by prioritising local firms in their procurement procedures.

Such actions have made an important contribution to software industry growth in developing countries, and have also expanded the base of software project skills (Heeks 1992c, Schware 1992). The main benefit has come where this process includes large-scale informatics projects. The main danger is these actions lead to US trade pressures like those which forced Brazil to open up its procurement.

H   Spread of Best Practice

The nature of software production in developing countries is epitomised by Mandurah's (1990) description of it in the Arab world - "very basic". While there are pockets of excellence, most software production cannot genuinely be described as a production process and bears no resemblance to the much-touted idea of the "software factory". Instead, it rather resembles a school art room - full of creative individuals using basic, outdated tools to their full capacity but involved in a "seat-of-the-pants" exercise which is barely managed at all[14].

As a result, overseas buyers are less willing to accept the products or services of developing country producers, so exports remain limited. Entry barriers remain low, allowing small, cheap, bad firms to enter and survive in the market. These firms often have marginal overheads and can substantially undercut their larger competitors. With many customers poorly attuned to notions of software quality but very well attuned to the "bottom line", this makes software production overly competitive, forcing prices down below economic levels on some contracts and reducing returns (and, hence, capital for reinvestment) for all software firms.

The practice of software development therefore needs strengthening by the state in three key areas:

i   More use of new technology, such as case (computer-aided software engineering) tools which automate aspects of the software development process. Because they replace labour with capital, these tools pose a significant danger to software exports from developing countries, substantially reliant, as

---

14   This is not, of course, an analogy limited to developing countries. Software production in the West is still dealt with far more as an art, and far less with techniques of management science than many wish to admit.

they are, on low labour costs. However, the greater danger will be in <u>failing</u> to adopt this new technology and increasingly lagging behind other producers who take advantage of the productivity and quality gains that the new technology can bring (Heeks 1990).

ii   More use of new techniques. At its most basic, this involves the use of simple project management techniques to gain greater control over the development process and so help to bring more work in on time, on budget. Over and above this, techniques such as formal methods can be adopted. These will be required for software producers to remain locally and globally competitive.

iii   Adoption of international quality standards. These form a subset of the new techniques to be adopted, but are of such significance as to be worthy of separate mention. There are many flaws in the conception of quality as a management issue, and it has been seized on far too uncritically as a panacea for improved organisational performance. However, while it remains "flavour of the month" it will become increasingly desirable and soon increasingly necessary for software firms - particularly exporters - to adopt quality standards. More and more Western clients will demand that their software suppliers have undergone certification procedures under, normally, the ISO 9000 quality standard (Dataquest 1993a).

Through procurement, the state can act in all three areas though few in developing countries have yet followed the lead of governments in the West. Government contracts stipulate, for example, that tenders can only be accepted from ISO-certified firms and that certain tools or methods (e.g. Structured Systems Analysis and Design Methodology) be used. There is also considerable indirect pressure to adopt other management techniques in order to meet time and cost deadlines.

The state can also act, as in Singapore, through best practice centres. These can have several functions:

-    to evaluate the condition of software development in the country and target areas of greatest need.

-    to inform by translating textbooks and international standards; by holding seminars at which those who have adopted best practice techniques talk to others; and by setting up demonstrator centres and projects where the various tools and techniques can be assessed. These centres can also inform local software purchasers of the need to demand certain minimum standards from local suppliers.

- to certify by acting as international standards certification centres, or by helping other organisations to become certifiers.

- to transfer by providing packs with "try-out" versions of new tools; by training university students and existing developers in new tools and techniques; and by subsidising training and acquisition of new tools.

- if necessary to establish a set of local standards. By demanding certification in such local standards for all government procurement, supposedly open tenders can favour local firms[15].

Finally, the state may provide finance. In Singapore and Ireland, for example, the state will provide a proportion (70% and 50% respectively) of a quality consultant's fee.

Of course, such "wish lists" can only be implemented when the importance of best practice is recognised within the state and when the requisite implementation skills are present. As discussed later, such requirements have significant implications for the structure and staffing of government.

I   *Other Intervention Areas*

- State-owned enterprises (SOEs). As Evans (1992) points out, the state can have three roles - as well as being a regulator and promoter, it can also be a producer. The fashion for privatisation has cast a shadow over public sector software firms in many countries, but this is not entirely justified. Although software industries mainly grow through private ownership, experience shows that publicly-owned firms can be profitable and play a lead role, especially in early industrial development. Thus, both Brazil's Cobra and India's CMC have built up a formidable base of innovatory skills. In the case of CMC, this has been successfully commercialised and even turned into export earnings.

However, the record of SOEs in other countries has been more mixed. In China, state firms have technological resources but it is the non-state ones that have the entrepreneurial perspective and talent. As such, it is clear that for software SOEs to work well, a particular set of conditions must hold such as avoidance of over-diversification, exposure to competition, appointment of entrepreneurial senior managers, and so on.

---

15 A number of states have also invested in the development of their own new software tools and techniques. While this has certainly created skills within the development centres, the wider value has yet to be proven.

- Sectoral development. The state can act to develop valuable software specialisms through the promotion of non-software sectors. For example, both Brazil and Uruguay have created financial software exports through development of, and investment in, their banking and financial services sectors. In these cases, the exports have been created by private firms and have been a fortunate spin-off from the promotion of the sectors rather than a deliberate objective.

- Trade. There has been a proven value in trade protectionism for young industries to allow time for import substitution and the growth of related capabilities, as seen in Brazil where import controls allowed substantial operating system-related capabilities to be created. Where this protectionism is absent, countries remain largely dependent on imports (Correa 1985).

Having said this, import policies - whether bans, quotas or tariffs - are of limited use given the intangibility of software which allows any policy to be circumvented with increasing ease (Heeks 1995). There is also a lot of "natural" local market protection based on language, regulations and knowledge of local needs. It is therefore hard to advocate a state regulatory approach to software trade.

- Multinationals (MNCs). As with trade protection, there are clear gains from regulating the activities of multinationals or - more accurately - clear losses from allowing them to act unfettered. However, regulation of multinationals has been fraught with problems in practice for two reasons. Firstly, by their nature, MNCs can act globally while states can only act nationally. Secondly, states are often caught in the weak and contradictory position of trying to encourage MNCs while trying to control them.

If regulation is to be attempted then it needs to be targeted at certain times and sectors. If the gap between domestic and foreign skills and technology is very large, then one might try to encourage multinationals to infuse new skills and technology. If the gap is very small, then local firms should be competitive and regulation can again be minimised. Control is only worthwhile to protect local firms when there is a medium-sized, "catch-upable" gap (Mody 1989). Unfortunately, defining gap size is not an exact science.

- Industrial licensing. Few governments have attempted to regulate companies' entry into or exit from software production. Evidence from India - where licensing was widespread during the 1970s and 1980s - suggests that it is often counter-productive, removing the incentive and route for firms to become competitive.

15

- Export subsidies. In almost all developing countries, the software export market provides greater returns on investment than production for the domestic market. As such, there is little justification for export subsidies to be paid by the state to software firms.

3   Conclusions

A global review of the "right kind" of state policy for software industry development and exports in developing countries indicates that wide-ranging state intervention is still essential to this industry. The common element guiding all the interventions has been the failure of the market to provide the quality or quantity of inputs which are critical to software industry success. As well as addressing the obvious inputs such as capital and labour, intervention has been needed to cover inputs such as market information and new development techniques.

While state intervention has been required most where market imperfections are greatest, it has also been found beneficial where, thanks to economies of scale, the state can be the most efficient provider. Examples include provision of core software skills and some items of marketing assistance and infrastructure. Finally, intervention may also be needed where market mechanisms produce outcomes that are not deemed to be in the best long-term interests of country, as seen in the emergence of overly-competitive industries in the absence of best practice action and, perhaps, in the need for legislation on IPRs. A full summary of areas for state intervention is presented in Appendix 1.

Clearly, the form of state intervention has changed over the past twenty or so years. Regulatory measures - some of which will still be of value in countries initially creating a software industry - are now giving way to measures which promote the growing industry and promote its access to inputs. Such measures are complex and multi-faceted compared to the relative simplicity of earlier intervention. In most countries, too, the state is now working alongside the private sector and public enterprises aiming for cooperative development rather than close control.

Of course, the list of interventions should not be taken as meaning that government intervention is a guarantee of software industry development, nor that state intervention - even promotional intervention - is perfect. In practice, there have often been problems with intervention.

In general terms, there have been delays, misunderstandings, inter-agency disagreements and - as seen in the case of software registers and hardware provision - interventions which have not had the desired effect. There have been other specific,

common problems such as poor commercialisation of academic innovations and weak links between business and academia for training (Baark & Heeks 1993, World Bank 1993).

However, a shortcoming, even a failure, of government intervention is not a logical argument for recourse to the market. It should, instead, be an argument for improved intervention next time.

Interventionist measures are not always right first time, and any given measure may become outdated by changing events. Therefore, just as important as the particular input addressed by promotional intervention is the strategy of intervention in general. Successful intervention strategies are those which are responsive to the industry's needs, and which are flexible and iterative - always trying to improve in the light of past experience and changing circumstances.

Because of this, one cannot universally prescribe a particular set of interventions which will bring success. Each country will have to choose the policy measures that suit its software industry best, based on continuous survey of the quantitative and qualitative nature of that industry.

This is also true because of the constraints placed on the process of making software industry policy. Policy outcomes will finally be determined not by some objective, technocratic choice of the "best path", but by a mixture of this "best path" intention with the balance of power and interests of the various elements in a country's political economy (Heeks 1992a). The outcome will also be determined partly by external factors, especially the actions of the US government and US companies which may try to block certain state interventions while encouraging others[16].

One may conclude that the argument should no longer be one of "State vs. Market" but a question of how to achieve the most from state and market working together. The continuum of importance here is not that which runs from "All State" to "All Market" but that which runs through a spectrum of different state responses to private industry (and autonomous public enterprises):

Supplanting	Regulating	Complementing	Promoting

---
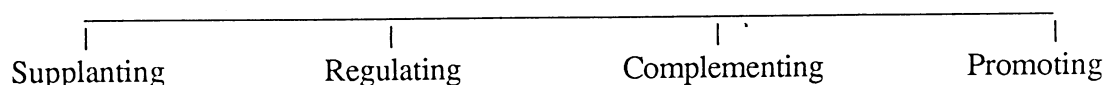
16 In addition to the 301-related pressures discussed above, Press (1991) cites the example of the US company Visible Systems which filed a claim against a Singapore firm's product, alleging that a subsidy paid by the Singapore government amounted to unfair competition.

Neither a completely state-owned nor a completely market-led approach to the software industry will create the conditions required for long-term industrial development. Yet, with alternatives to the market being too rarely presented, many countries are being pushed under pressure of structural adjustment along a path from the regulatory state to the minimal state (path A in figure 1).
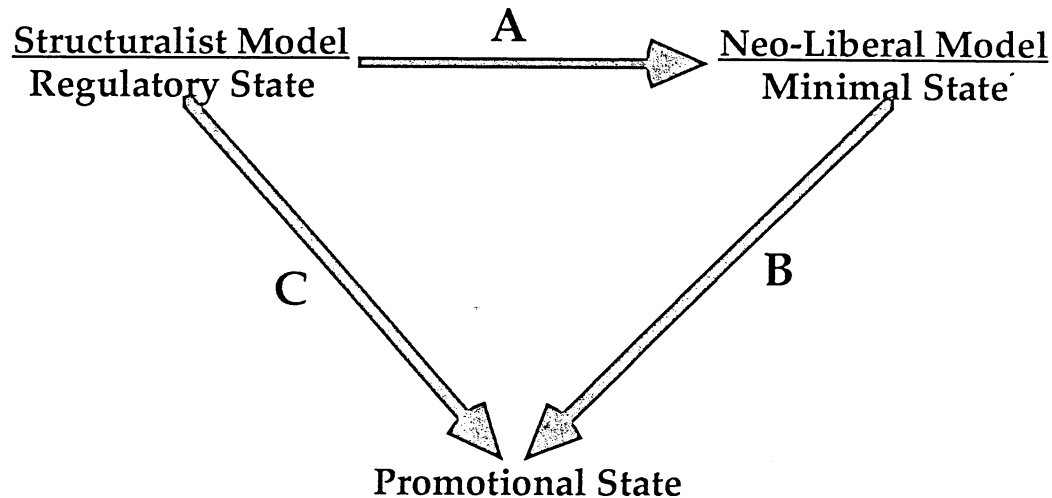

Figure 1: State Roles and Developmental Paths

This seems most likely to occur in countries where policy has been guided more by ideology than pragmatism; where politicians, business people and the public are accustomed to seek simple solutions; where an inferiority complex predisposes the government towards external policy models; and where there is a continuing belief in the autonomous power of the state. In these circumstances, policy may flip from one ideology to another - from overactive embracing of state to overactive embracing of market[17]. There is likely to be a long and wasteful process before these states recognise the need to change once again and move along path B.

Such countries sit in marked contrast to those who have recognised that, instead, the push should be along path C from the regulatory state to the promotional state. These nations, such as those of South-East and East Asia, have been successful because - due to their particular political economies - they have been able to forge a cooperative alliance between state and industry, rather than ending up in a situation in which one or

---

17 Evans (1992) illustrates the danger of such a situation in the dissipation of innovative skills built up within the state-owned Computadores Brasilieros. Once the state model had run into difficulties, the only solution was seen to be total private ownership. One might have expected something similar from India but the Department of Electronics - unlike much of the Indian bureaucracy - has striven since the mid-1980s to assist industry, and so is transforming itself from a regulatory to a promotional body (Dataquest 1993b).

the other is ideologically dominant. The state's role is seen as one that promotes industry and development rather than promoting ideology.

Implications of the State's Promotional Role

Three further implications are worthy of note.

Firstly, the structure of state organisations must be such that they can respond quickly to industrial needs and to changes in both markets and technology. Giving such organisations a measure of autonomy does seem to have been associated with greater responsiveness and more effective performance.

Joint industry-state consultative structures are also required but must be carefully planned so that the state can fulfil a role that is more than being merely the servant of industry or market. Examples include Taiwan's Industrial Development Bureau or South Korea's Council of Software Industry Promotion.

There may be some mileage in centralisation and coordination. This could take place at the level of policy-making, for example in the creation of, as the World Bank (1993) suggests, a Ministry for Informatics. It could also take place at the level of implementation, with a public sector centre undertaking activities such as those described for the Singapore best practice centre and for what Borrego (1992) terms an "IT observatory". This could include monitoring local and international markets and changing technologies; acting as the focus for dissemination of information and the spread of best practice; and undertaking research and development work.

Secondly, there may be far-reaching implications for state representatives and human resource development. No longer bureaucrats, the staff must now be technocrats with a set of professional skills in economics; human resource development; marketing; the law; and so forth. They will need training and will be assisted by career paths that allow movement from industry to state and vice versa[18].

Finally, one would never seek to deny the importance of sound financial management and, to some extent, markets in the development of software production and software exports, but there are more than enough organisations and consultants around the world reminding everyone about this. What this paper has reinforced is the much less fanfared message - that the state continues to play an essential role in the process of industrial development.

---

18 One of the few advantages of externally-induced liberalisation is that it may create the basis for a reorganisation and reorientation of state structures, working conditions and staff attitudes which has been difficult to achieve under more incremental processes of change.

This should be the basis for a renewal of confidence in the role of the state. Such a renewal is much needed within the state but also within industries such as the software industry. Too often, industrialists react to liberalisation and the lifting of what they see as the "shackles of state interference" by seeking a future devoid of state intervention. Until they recognise that some forms of state intervention are indispensable, such industrialists will be constraining the long-term development of their own industries.

Future Research Directions

There is an increasing body of evidence about the software industries of developing countries. Nevertheless, more case studies are required. Basic and reliable facts, figures and descriptions are still lacking for many countries. Building on these, there must be wider application of critical, analytical perspectives which combine macro- and micro-level research.

One aspect of the need for a critical approach, which questions what have come to be accepted truisms, was clearly identified above. This was the need to understand more about the behaviour of firms which produce software packages under conditions of high piracy and little anti-piracy legislation. The "accepted truth" that action on piracy is good for software industry development needs to be thoroughly examined.

Given its rather generalised conclusions about policy best practice, this paper highlights three main areas for further investigation:

- The implications of national differences for software policy.

- The barriers that prevent both state officials and industrial managers learning about and accepting lessons of best practice.

- The barriers that prevent implementation of supportive state interventions, particularly the barriers within a nation's political economy.

This paper builds on a small but active debate about issues of state policy. Its presence highlights the absence of any significant literature on organisational-level strategies for software industry growth in developing countries. Both state and industry are very receptive to any findings that can be presented on this topic.

Finally, the central issue could be reversed, to focus not on the multi-faceted and changing nature of the state but on the multi-faceted and changing nature of software-related markets.

National Software Policy References

Countries listed in brackets at the end of a reference indicate those for which evidence is presented in that reference and used in this paper where this is not otherwise obvious from the title.

Brazil

Gaio, F J (1989) The Development of Computer Software Technological Capabilities in Developing Countries - a case study of Brazil. PhD thesis, University of Sussex.

China

Baark, E (1990) China's software industry. Information Technology for Development, 5(2), 117-36.

Elliot, S (1993) Intellectual property right protection for software: developments in China. Information Technology in Developing Countries, 3(1), p11.

India

Dataquest (1993b) The DoE: pre and post Vittal. Dataquest, Sept 1993, 123-24.

Evans, P B (1992) Indian informatics in the 1980s: the changing character of state involvement. World Development, 20(1), 1-18. [South Korea, Taiwan]

Heeks, R B (1991a) State Policy, Liberalisation and the Development of the Indian Software Industry. PhD dissertation thesis, Open University, Milton Keynes, UK.

Iran

Barraclough, C (1992) Iranians build their own software house. Financial Times, 23/4/92.

Ireland

Computing (1993) Sun sets up Irish software centre. Computing, 11/3/93, p8.

Mexico

Borrego, J A (1992) The Development of the Software Industry in Mexico. Science Policy Research Unit, University of Sussex, Brighton, UK. [Singapore]

Multi-Country

Correa, C M (1985) Trends in Commercialization of Software in Developing Countries. IS.574. UNIDO, Vienna. [Brazil]

Correa, C M (1990a) Software industry: an opportunity for Latin America?. World Development, 18(11), 1587-98. [South Korea]

Mandurah, M M (1990) Software industry in Arab Countries: status, current issues and future directions. Information Technology for Development, 5(2), 157-75.

Press, L (1991) Personal computers and the world software market. Communications of the ACM, 34(2), 23-28. [Ireland, Taiwan]

Rigg, M & Mejias, R (1992) Information technology in Uruguay and Paraguay. In: Social Implications of Computers in Developing Countries, S C Bhatnagar & M Odedra (eds), 124-33, Tata McGraw-Hill, New Delhi.

Schware, R (1987) Software industry development in the Third World: policy guidelines, institutional options and constraints. World Development, 15(10/11), 1249-67. [Singapore]

Schware, R (1992) Software industry entry strategies for developing countries. World Development, 20(2), 143-64. [Brazil]

World Bank (1993) Turkey: Informatics and Economic Modernization. World Bank, Washington, D C. [Hungary, Ireland, Israel, Japan, Philippines, Singapore, Taiwan]

Singapore

Gurbaxani, V. et al (1990) Government as the driving force toward the information society: national computer policy in Singapore. The Information Society, Vol.7, 155-85

Heng, T M & Low, L (1993) The intelligent city: Singapore achieving the next lap. Technology Analysis & Strategic Management, 5(2), 187-202.

Taiwan

Gwynne, P (1993) Taiwan to develop local software industry. Research - Technology Management, Jan-Feb 1993, 3-4.

Other References

Anderson, C (1993) The rocky road to a data highway. Science, 260, 1064-65.

Baark, E & Heeks, R B (1993) UNDP Technology Transfer Projects in China. Evaluation report to UNDP Beijing office.

Coopers and Lybrand/IDC (1986) Computing Services Industry 1986-1996. Coopers and Lybrand, London.

Correa, C M (1990b) Software protection: a case study on the development of economic law. Information Technology for Development, 5(2), 195-217.

Dataquest (1993a) Quality: the new mantra. Dataquest, Feb 1993, 136-62.

Fialkowski, K (1990) Software industry in the developing countries: the possibilities. Information Technology for Development, 5(2), 187-94.

Heeks, R B (1990) Fourth generation languages (4GLs) and the Indian software industry. In: Information Technology in Developing Countries, S C Bhatnagar & N Bjorn-Andersen (eds), 251-63, North-Holland, Amsterdam.

Heeks, R B (1991b) New technology and the international divisions of labour: a case study of the Indian software industry. Science, Technology & Development, 9(1/2), 97-106.

Heeks, R B (1992a) Constraints on and support for industrial policy liberalization in India. Development Policy Review, 10(1), 15-34.

Heeks, R B (1992b) Software exports' poorer cousin. Dataquest, Feb 1992, 145-47.

Heeks, R B (1992c) Strategies for indigenising IT production in developing countries. In: Social Implications of Computers in Developing Countries, S C Bhatnagar & M Odedra (eds), 110-23, Tata McGraw-Hill, New Delhi.

Heeks, R B (1993) Software subcontracting to the Third World. In: Social Dimensions of Systems Engineering, P Quintas (ed.), 236-50, Ellis Horwood, Hemel Hempstead, UK.

Heeks, R B (1995) India's Software Industry: State policy, liberalisation and industrial development. Sage, New Delhi. (In press)

Kopetz, H (1984) Guidelines for Software Production in Developing Countries. IS.440. UNIDO, Vienna.

Mody, A (1989) Strategies for developing information industries. In: Technology and Development in the Third Industrial Revolution, C Cooper & R Kaplinsky (eds), 38-59, Frank Cass, London.

Narasimhan, R (1984) Guidelines for Software Development in Developing Countries. IS.439. UNIDO, Vienna.

Platz, B (1992) Software export industry: prospectives and problems. In: Technology Transfer for Development?, G Cyranek & S C Bhatnagar (eds), 111-17, Tata McGraw-Hill, New Delhi.

Schware, R (1989) The World Software Industry and Software Engineering. World Bank technical paper no. 104. World Bank, Washington DC, USA.

Schware, R (1990) Software for developing countries: major issues for the 1990s. Information Technology for Development, 5(2), 101-107.

UNIDO Secretariat (1983) Problems of Software Development in Developing Countries. IS.383. UNIDO, Vienna.

Wagstyl, S (1993) Indians key into the market for software. Financial Times, 18/2/93.

Wahi, K S (1993) Are Western Models of Science Park Appropriate for the Developing Countries? MA dissertation, University of Manchester.

APPENDIX 1: Areas for Government Intervention in IT Industry Development

DEMAND SIDE (IT users)	ENVIRONMENT & INFRASTRUCTURE (bridging demand & supply)	SUPPLY SIDE (IT suppliers)
Information dissemination • awareness activities, national seminars, visits • market research & development	Strategy formulation and coordination • coupling supply and demand initiatives, organisations, policies • strengthening coordination, monitoring	Research • R&D programmes and consortia • R&D loans • R&D tax incentives
Demonstration projects • process application support • product development support • public administration modernisation	Telecommunications policies and investments • private participation in value-added services • competition • accelerated modernisation	Research institutions • strengthening & restructuring
Adoption incentives • consultancy assistance • tax incentives	Standardisation • to strengthen supply & facilitate adoption	Export promotion programmes • Foreign recruitment & strategic alliances
Technological capability development • adoption skills development • decentralised application centres • extension schemes, consultancy development	Legal framework • software protection • access to public information	Industrial policy/strategy • access to foreign technology • assistance to small enterprises • special finance to software firms promoting subcontracting • subsidy to national champions
Procurement • public procurement policies	Education • electronics & software engineering • managers & professionals • mass media • computer literacy	Software quality & productivity • enhancement programmes
IT users/consultancy associations • strengthen & use professional associations • clearinghouses, information networks	Competition and trade policies	Software technology parks • specialised services & common facilities
		IT industry & trade associations • strengthen, use, link

Source: World Bank (1992) India: An Information Technology Development Strategy. World Bank, Washington DC, USA.

DEVELOPMENT POLICY AND PRACTICE

The Development Policy and Practice Research Group was set up in the Open University towards the end of 1984 to promote research on development issues. Its members have a wide range of disciplinary backgrounds (engineering, sociology, economics, education, geography and anthropology). At present, research is focused in four areas:

(i)   Food production and food security, focusing particularly on exchange relations and foodgrain markets;

(ii)   Alternative technological capabilities and the implications of different technological strategies for development;

(iii)   Women, children and households: the social and cultural context of employment and livelihoods, children and social policy;

(iv)   'Managing development' and policy as process: the role of national and international non-governmental organisations.

DPP is relatively small research group with limited funding. In order to increase our efficacy we are keen to enter into collaborative arrangements with other groups and development agencies where appropriate. DPP will also be acting as a centre to focus the development concerns of the Open University by arranging seminars and workshops. DPP can be contacted at the following address:

> Development Policy and Practice
> Technology Faculty
> The Open University
> Walton Hall
> Milton Keynes
> MK7 6AA
> United Kingdom
>
> Telephone: 0908 652103/654108
> Fax: 0908 654825/653744

DEVELOPMENT POLICY AND PRACTICE GROUP

Paper No	Author	Title
1	M Mackintosh	Agricultural marketing and socialist accumulation: a case study of maize marketing in Mozambique
2	L Harris	Finance and money with underdeveloped banking
3	H Bernstein	Capitalism and Petty Commodity Production
4	B Crow	US policies in Bangladesh: the making and the breaking of famine?
5	M Mamdani	Extreme but not exceptional: towards an analysis of the agrarian question in Uganda
6	B Crow	Plain tales from the rice trade: indications of vertical integration in foodgrain markets in Bangladesh
7	T Painter	Migrations, social reproduction, and development in Africa: critical notes for a case study in the West African Sahel
8	N Amin	Characteristics of the international rice markets
9	M Mackintosh and M Wuyts	Accumulation, Social Services and Socialist Transition in the Third World:reflections on decentralised planning based on Mozambican experience
10	P Woodhouse	The Green Revolution and Food Security in Africa: issues in research and technology development
11	N Amin	Maize Production, Distribution Policy and the Problem of Food Security in Zimbabwe's Communal Areas
12	A Akcay	From Landlordism to Capitalism in Turkish Agriculture
13	T Evans	Economic Policy and Social Transition in Revolutionay Nicaragua
14	L Harris	Theories of Finance and the Third World
15	T Hewitt	Skilled Labour in R & D: a case study of the Brazilian computer industry
16	H Bernstein	Agricultural "modernisation" in the era of structural adjustment
17	R Heeks	New Technology and International Division of Labour: A Case Study of the Indian Software Industry

18	B Crow and K A S Murshid	The Finance of Forced and Free Markets: Merchants' Capital in the Bangladesh Grain Trade
19	B Crow and A Lindquist	Development of the Rivers Ganges and Brahmaputra: The Difficulty of Negotiating a New Line
20	P Woodhouse and I Ndiaye	Structural adjustment and irrigated food farming in Africa: The "disengagement" of the state in the Senegal River Valley
21	F Ginwala, M Mackintosh and D Massey	Gender and Economic Policy in a Democratic South Africa
22	J M Nxumalo	The National Question in the Writing of South African History. A Critical Survey of Some Major Tendencies
23	P Cawthorne	The Labour Process Under Amoebic Capitalism: A Case Study of the Garment Industry in a South Indian Town (Revised and Inclusive)
24	P Mollinga	Protective Irrigation in South India Deadlock or Development In conjunction with the Department of Irrigation and Soil and Water Conservation, Wageningen Agricultural University, the Netherlands
25	G Wilson	Technological capability in small-scale development projects supported by UK-based NGOs
26	B Harriss	Markets, Society and the State: Problems of Marketing Under Conditions of Small Holder Agriculture in West Benegal. Report to the World Institute for Development Economics Research (WIDER), Helsinki, Finland
27 Fortcoming	D Abbott	Methodological Dilemma of Researching Women's Poverty in Third World Settings: Reflections on a Study Carried Out in Bombay
28	A Thomas	What is Development Management?
29	J Mooij	The Political Economy of the Essential Commodities Act
30	R Heeks	From Regulation to Promotion: The State's Changing but Continuing Role in Software Production and Export

Joint -DPP and University of Zimbabwe

Joint 1	N Amin and N Moyo	Development and Crisis in Sub-Saharan Africa: A Critical Comment
Joint 2	J Chipika	Poverty Food Insecurity and the Child Malnutrition Problem in Rural Zimbabwe. The case of Mashonaland West Province
Joint 3	N Amin and J Chipika	A Factor-Analytic Approach to Peasant Differentiation and Household Food Security in Zimbabwe