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CHANGES IN THE DEFENCE INDUSTRY

by
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Abstract

In 1989 the end of the cold war was brought about by diplomatic and political change. The defence industries, which had previously benefitted from stable and steadily growing military expenditure, were faced with a long term decline in domestic and world markets. While there were decreasing arms industries in the main supplier countries, other countries, particularly the emerging nations with growing economies, increased the level of arms production. The traditional arms suppliers competed to gain a market share in these countries and offered technology transfers, offsets and licensed production arrangements. The arms industrialists of the traditional supplier nations have become concerned that licensed manufacturing leads to countries eventually setting up their own production. The relationship between licensed and indigenous production of arms presented a fruitful area of research. The hypothesis investigated in this study was that:

licensed production leads to indigenous production of arms.

Three methods were used to test the hypothesis: (a) a macro-analysis of the numerical data collated on twelve countries' arms production over twenty five years, (b) four case studies of the arms production of ASEAN, Australia, Japan and Israel and (c) a survey by questionnaire of arms dealers and suppliers. Finally, validation interviews were carried out with a panel of experts on weapons production and arms trade who were asked to comment on the findings of the studies.

All three studies gave the same result that the value of indigenous production is not a result of the value of licensed production of arms. The panel of experts found that the result of the studies corresponded to their understanding and experience of the arms industry: joint ventures and licensed production were used to establish a domestic arms industry but the impetus for setting up and carrying out both licensed and indigenous production came from strategic, political and economic motives and the socio-economic background of the particular country.
I would like to thank my supervisor Dr Peter Kangis of the Surrey European Management School of the University of Surrey who provided guidance, encouragement, assistance and friendship. I am grateful to Mr R.G.Bamford, Professor Gamble, Dr Michael Kipps and Dr R Phelps for their continued support and encouragement. I would like to thank Dr W.S.(Bill) Bardo who has helped so many engineers in their professional and academic careers for useful discussions and support.
Dedicated to my parents

Ann Coker and Norman Cecil Coker
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<td>ASEAN</td>
<td>Association of South East Asian Nations</td>
</tr>
<tr>
<td>BAe</td>
<td>British Aerospace</td>
</tr>
<tr>
<td>CMEA</td>
<td>Council for Mutual Economic Assistance</td>
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<tr>
<td>DOD</td>
<td>Department of Defense</td>
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<td>EU</td>
<td>European Union</td>
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<tr>
<td>EFA</td>
<td>European Fighter Aircraft</td>
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<td>EUCLID</td>
<td>European Cooperative Longterm Initiative on Defence</td>
</tr>
<tr>
<td>IEPG</td>
<td>Independent European Program Group</td>
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<tr>
<td>Laser</td>
<td>Light amplification by stimulated emission of radiation</td>
</tr>
<tr>
<td>MOD</td>
<td>Ministry of Defence</td>
</tr>
<tr>
<td>MOU</td>
<td>Memorandum of Understanding</td>
</tr>
<tr>
<td>NATO</td>
<td>North Atlantic Treaty Organisation</td>
</tr>
<tr>
<td>OECD</td>
<td>Organisation for Economic Development</td>
</tr>
<tr>
<td>PADC</td>
<td>Philippine Aerospace Development Corporation</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and development</td>
</tr>
<tr>
<td>SACEUR</td>
<td>Supreme Allied Commander, Europe</td>
</tr>
<tr>
<td>SALT</td>
<td>Strategic Arms Limitation Treaty</td>
</tr>
<tr>
<td>SDI</td>
<td>Strategic Defense Initiative</td>
</tr>
<tr>
<td>SIPRI</td>
<td>Stockholm International Peace Research Institute</td>
</tr>
<tr>
<td>START</td>
<td>Strategic Arms Reduction Talks</td>
</tr>
<tr>
<td>WEU</td>
<td>Western European Union</td>
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<td>WTO</td>
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Chapter 1

Relationship between government and the defence industry
Chapter 1

1. THE RELATIONSHIP BETWEEN THE GOVERNMENT AND THE DEFENCE INDUSTRY

1.1 BACKGROUND - OPTIONS FOR CHANGE AND THE REDUCED DEFENCE BUDGET

Since the end of World War II the British defence policy has been designed almost entirely to deter any threat to western Europe from the Warsaw Treaty Organisation (WTO) and has involved a strong commitment to the North Atlantic Treaty Organisation (NATO). Kiely (1990) has described how NATO was founded in 1949 following the Soviet blockade of Berlin. NATO provided a military balance for Western Europe and the United States of America against Soviet aggression. NATO became a highly effective political organisation and one of the longest and most successful military alliances in modern history. There are several publications specialising in defence policies of nations, for example IISS's yearly book "Strategic Survey". Jane Sharp in the Written Evidence to The Defence Committee Tenth Report (p.80 to p.83) describes how since 1989 there has been significant change in the assessment of priority threats and Her Majesty's Government (HMG) policy has been profoundly influenced by the Conventional Forces in Europe (CFE) negotiations, by the political and military changes in the WTO, the unification of Germany and the agreement on a new strategy for NATO.

The British Government announced defence cuts in the Defence Secretary's Statement to Parliament "Options For Change" which was published in July 1990 and the declining defence budgets have been reconfirmed in the 1991 and 1992 "Statement
For Defence Estimates*. Defence spending which was reduced by 10% over the preceding five years were budgeted to reduce by 6% in real terms over the next three years.

The size of the defence budget and its allocation have a major impact on the defence industry, in ship building, in the armoured vehicle sector, in aerospace and electronics industries and in many other industries which are direct or indirect suppliers of products or services to those industries. The Commission of the European Communities became highly concerned about the impact of declining defence budgets on these industries and commissioned a report to be carried out by Eurostrategies (Eurostrategies, 1991). The report concluded that the decline and the restructuring process of the defence industry were so fundamental that even the occurrence of the Gulf War would not reverse it and it was predicted that approximately one third of the 1.5 million jobs in the European defence industry would be lost.

There have been concerns that cutting military contracts would have immediate deleterious effects on the UK economy. It has been predicted (Electronics Times, 11 June 1992, p. 1) by the MOD and DTI that the cancellation of the European Fighter Aircraft programme would result in the reduction by billions of pounds of the share values of 34 main contractors and 60 subcontractors, a loss of 32000 jobs and a cost of £280M per year to the Treasury in lost income tax and national insurance. A further concern (Electronics Times, 23 January 1992, p. 10) was the resultant loss of manufacturing development and skill in the engineering industry.
1.2 THE RELATIONSHIP BETWEEN GOVERNMENT AND THE DEFENCE INDUSTRY

There are several studies on the defence industry and the defence market which show how the relationship between government and the defence industrial base has developed and changed. The study of British and the European armaments market undertaken by Walker and Gummett (1989) highlighted the changes in British defence procurement policy from 1980 to 1989. These are summarised in the following sections.
1.3 PERIOD OF HIGH DEFENCE SPENDING, 1980-1985

During the early 1980s, the British Conservative government attached great importance to military power (Walker and Gummett, 1989) and undertook a programme of strengthening the armed forces and upgrading its nuclear deterrence capability and consequently UK industry benefited from sustained high defence equipment procurement budgets. The literature reviewed has not considered that the equipment procurement programmes during this period were focused on several major projects to the detriment of other programmes which were afforded lower priority. The available airframe funding was directed to the Tornado aircraft programme and the associated air launched weapons, leaving very little support for other airframe programmes. Table 1.3 shows how the funding available for fixed wing and rotary wing airframe programmes was dominated by the Tornado programme.
TABLE 1.3 Major airframe projects current in 1985

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<tr>
<th>MAJOR AIRFRAME PROJECT</th>
<th>TOTAL AIRFRAME PROJECT DEVELOPMENT AND PRODUCTION COST AT AVERAGE 1985/86 PRICES</th>
</tr>
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<tbody>
<tr>
<td>AIRCRAFT</td>
<td></td>
</tr>
<tr>
<td>Tornado</td>
<td>9200 £M</td>
</tr>
<tr>
<td>Nimrod MR MK 2</td>
<td>850 £M</td>
</tr>
<tr>
<td>Nimrod Airborne Early Warning MK3</td>
<td>Not quoted, under review in 1985.</td>
</tr>
<tr>
<td>Harrier GR5</td>
<td>1200 £M</td>
</tr>
<tr>
<td>HELICOPTERS</td>
<td></td>
</tr>
<tr>
<td>Lynx</td>
<td>1100 £M</td>
</tr>
<tr>
<td>Sea King</td>
<td>600 £M</td>
</tr>
<tr>
<td>Chinook</td>
<td>250 £M</td>
</tr>
<tr>
<td>EH 101</td>
<td>1450 £M</td>
</tr>
</tbody>
</table>

Source: Table by current author, adapted from table presented in Second Report from the Defence Committee, Session 1985-86, p. 132.

The nuclear Trident programme absorbed a substantial portion of funding. The peak of Trident expenditure was estimated at between 11 and 20 per cent of the defence equipment budget (Third Report from the Defence Committee, Session 1984-85, p. 322, paragraph 2021) and about 33 per cent of the naval equipment budget (Third Report from the Defence Committee, Session 1984-85, p. 331, paragraph 18.B(ii) Q. 1115). These programmes offered the prime-contractor companies profits from the high added values. However, during this period other areas were down-graded in priority and there was a moratorium on defence spending for other programmes particularly for naval requirements. The outlook for the British naval shipbuilding industry looked bleak, until the Falklands conflict caused the government to abandon or delay its plans for deep cuts in the navy.

Whilst these programmes gave the government the display of military power it sought, (Walker and Gummett, 1989, p. 420), there was growing concern in
Whitehall about several aspects of the defence market, particularly:

- lack of competition between defence companies in the United Kingdom,
- a too close relationship between industrialists, civil servants and the military,
- cost escalation and lack of cost control,
- inefficiency in both defence research and development and in production.

Escalating costs were seen on several major programmes such as Polaris and Nimrod Airborne Early Warning Aircraft (Table 1.3). The lack of cost control, the high cost of defence and the need for reform have been studied by Deger (1981), Dunne and Smith (1983), Hartley (1987), Hartley and Hooper (1987), Hartley, Hussain and Smith (1987), Smith (1987) and Smith (1988) who stressed the need for reform in defence equipment procurement.

During these years of high military equipment spending, defence was seen as an attractive market and defence contractors grew by acquisition of smaller defence contractors (Walker and Gummet, 1989, p. 422). Walker and Gummet (1989, p. 423) report the takeover of the government-owned Royal Ordnance Factories and Austin Rover and they quote an unnamed French industrialist as saying:

"The problem for the British Government is that it now has two ministries of defence - one called the Ministry of Defence, the other called British Aerospace."
1.4 REVISED PROCUREMENT, THE LEVENE REFORMS, 1984-1988

The period from 1984-5 to the present (1996) is associated with competitive procurement. The changes in defence procurement methods are widely known as the Levene reforms, named after Sir Peter Levene, the Chief of Defence Procurement in the UK Ministry of Defence, appointed in 1985. The main features of the Levene reforms have been described by Walker and Gummett, (1989):

- competitive tenders, where suppliers compete for development and production contracts,
- fixed price contracts,
- tighter contractual terms,
- revised payments procedures, where payment is dependant on progress,
- new arrangements for risk sharing between government and industry.

The Levene reforms allowed the major prime contractors to increase their dominance of the defence market. British Aerospace, Rolls-Royce and Vickers Shipbuilding maintained their near monopolies in aircraft, aero-engines and submarines. Whilst the Ministry of Defence sought to reduce both its management of major contracts and the role of the Government defence research agencies, the contractors became increasingly dominant in contract management and in research and military technology. The financial and technical controls of prime-contract and major contract management, the control of sub-system and component procurement and the control of the advanced technology base began to shift from the MOD to the major prime contractors.
Chapter 1

PRIVATISATION

Anthony (1993) reported that the UK Prime Minister Margaret Thatcher started a denationalization programme of defence industries and several defence industries were privatised: Rolls-Royce, British Aerospace, VSEL, Swan Hunter, Vosper Thornycroft, Yarrow Yard, Royal Ordnance, Devonport and Shorts. Schneider (1993) reported that privatisation in European defence industry advanced most significantly in the UK and in Germany (i.e. in the former Federal Republic of Germany). Schneider reported that the same pattern of privatisation was not seen in France, where the French government chose to retain state ownership of the major elements of the defence industry.

The government in its efforts to increase competition and to achieve wider choice, sought to widen the supplier base by bringing in new UK suppliers from other market sectors such as software and telecommunications and from European contractors and elsewhere.

During this period the government tried to discourage mergers and monopolies, which they considered would reduce competition, for example in 1986 the bid by GEC for Plessey was blocked by the Monopolies and Mergers Commission (Morgan, 1989 and Walker and Gummett, 1989, p. 422). It is noted that Sir Peter Levene, the former Chief of Defence Procurement in the UK Ministry of Defence who advocated a policy of increased competitiveness for defence procurement (Walker and Gummett 1989), was in 1992 with the takeover specialists Wasserstein Perella (Electronics Times 16 January 1992, p. 11).
Some UK defence companies such as Lucas and Smiths Industries were successful in achieving growth in the USA by embarking on a series of acquisitions which gave them direct access to the US civil aerospace market (Eurostrategies Report, 1989). Gee (1988) and Stodden (1988) describe how in 1987 the UK-based Smiths Aerospace and Defence Group acquired a portion of the USA group Lear Siegler Inc and the units were renamed SLI Avionics Systems Corp and SLI International Corp. The acquisitions doubled the level of Smiths avionics business and by 1988 approximately one third of Smiths' employees were based in the USA and Smiths achieved defence contracts to the value of 100 Million ECUs to the US Department of Defence (Eurostrategies Report, 1991).

There were also some disastrous acquisitions as defence companies sought to acquire high-technology companies with unproven or suspect management credibility. The catastrophic result of the merger between the UK company, Ferranti and the USA company, International and Control, ISC was widely reported in the media. Electronics Times (18 June 1992, p. 12) reported that Ferranti were defrauded of $189M, 3500 Ferranti employees lost their jobs and a chief executive of ISC, James Guerin, was sentenced to 15 years imprisonment.

1.5 THE END OF THE COLD WAR 1989

Kiely (1990) reports that during 1989 and 1990 following the destruction of the Berlin Wall and the break up of the Warsaw Pact, there was great hope for world peace and security. A perception was that communism and fascism were collapsing.
The events have been catalogued by the International Institute for Strategic Studies in their publication, Military Balance 1991-1992 and by the Stockholm International Peace Research Institute in the SIPRI Yearbook 1990. Mikhail Gorbachev had brought fundamental change to Soviet policy. There was the Soviet withdrawal from Afghanistan. America made substantial cuts to its military Strategic Defense Initiative programme (SDI). At a United Nations speech in December 1989 Mikhail Gorbachev announced the economic failure of the communist system. On 9th November 1989 the worldwide media watched the Berlin Wall being opened. By the end of 1989 the world witnessed revolutions in all the Eastern and Central European allies of the USSR, all peaceful except for Romania:

- Poland. On 19th August 1989 a non-communist government was appointed.
- Czechoslovakia. On 29th December 1989 the former opposition member, Vaclav Havel was elected president.
- Hungary announced a free voting procedure for future elections for the presidency.
- In Romania the revolution was bloody because the Securitate police used force against the Romanian population. President Ceausescu and Elena Ceausescu were arrested by the Romanian Army and executed on Christmas Day 1989.
- By the end of 1989 Albania was the last stronghold of communism left in Eastern Europe. In the first multi-party elections in March 1991 the ruling communist party retained power, but since then Albania has resumed diplomatic relations with a number of countries and has abandoned its
traditional policy of isolation.

On 1st April 1991 the Warsaw Pact ceased to exist as a military alliance and the Treaty was formally and finally terminated on 1st July 1991 at the final meeting of the Warsaw Treaty Political Consultative Committee in Prague.

1.6 THE UNSTABLE WORLD AND THE END OF THE MILITARY BALANCE

Kiely (1990) pointed out that the expectation that the world would become more peaceful as a result of these changes was premature. The "Military Balance", that was the military balance between the world superpowers and their military dominance on the world was destabilised and with the dominance of the superpowers removed there emerged potential opportunities for military conflicts based on economic, political, international and technological developments.

Saracino (1993) considered that with the break up of the Warsaw Pact, the world has witnessed an unprecedented level of ethnic violence and civil strife. The lid of the pressure cooker that was Soviet control has been removed and old scores are being settled. Saracino (1993) considers that the removal of Soviet control has led to greater instability in Eastern Europe, the conflict which started in 1991 in the former Yugoslavia being a prime example. Saracino (1993) concluded that there has been no "peace" dividend in terms of peace and that if the war in the former Yugoslavia were to continue, there would be an increasing probability of the violence migrating to countries such as Macedonia, Albania and Montenegro.
In his report on the United Nations, Saracino (1993) expresses the view that unless the United Nations has both the financial and the political will to act as the world's policeman, the role will fall by default to the USA. The United Nations is the only political body with a mandate to enforce international law. Global defence expenditure at the end of the 1980-1990 decade reached nearly US$1 trillion per annum, equivalent to US$2 million per minute, whereas the cost of the United Nations peace keeping operations in 1993 is US$3 billion per annum.

Figure 1.6.1 shows the locations of the major armed conflicts in the world during 1989 (as defined by Lindgren et al, 1990) where a conflict has incurred more than one thousand battle-related deaths. Lindgren identified 32 locations of major armed conflicts and in some locations there were several conflicts being fought simultaneously. Not shown on the Figure 1.6.1 are 75 major conflicts where the total number of battle related deaths is less than the one thousand level. Figure 1.6.2 shows the locations of the countries with nuclear weapons capability and those countries believed to be building nuclear weapons capability (SIPRI Yearbook 1990) and having a nuclear weapons programme (The Economist, Volume 34, Number 7775, 1992 and Sunday Express 10 January 1993, p. 18). Figure 1.6.3 shows those unstable areas of the world where democracies may be forced or may choose to intervene in military conflicts. The Economist (Volume 34, Number 7775, 1992) considered that democracies may be drawn into "wars of interest" and "wars of conscience".

Where there are "wars of interest" the democracies are considered likely to intervene
because there may exist an economic interest in those areas, for example for a strategic raw material. A high risk area identified in the Economist (Volume 34, Number 7775, 1992) is the oil-rich Muslim Crescent of North Africa, the Middle East and South West Asia.

The Economist characterised "wars of conscience" as occurring in those countries where there may be separate racial or religious groups and where there may be group-against-group savagery. It was considered that democracies may intervene militarily where the savagery is too horrifying for democracies to ignore and not necessarily where the democracies interests are threatened. Examples are seen in the former Yugoslavia and large areas of Africa, Asia and Latin America.
FIGURE 1.6.1

Locations of armed conflicts in 1989, where there have been more than 1000 deaths as a result of the battle.

Figure by current author from data presented by Lindgren et al in SIPRI Yearbook 1990.
FIGURE 1.6.2

Locations of countries with nuclear capability

Map by current author from data presented in the references.

KEY:

Red: Locations of countries with nuclear capability in 1989
Source: Sipri Year Book 1990

Blue: Locations of countries possibly building nuclear capability
Source: Sunday Express 10 January 1993, p 16
and The Economist, Volume 324, Number 7775, 1992
FIGURE 1.6.3

The unstable world where democracies may intervene with military force

KEY:

Green: WARS OF CONSCIENCE, COUNTRIES WHERE THERE MAY BE SEPARATE RACIAL OR RELIGIOUS GROUPS, WHERE THERE MAY BE GROUP AGAINST GROUP SAVAGERY.

- Where savagery is too horrifying for democracies to ignore, but not necessarily where a democracy's economic interest is threatened.
- Where within a country there are separate racial or religious identities and there can be group against group savagery.
- Examples are the former Yugoslavia and large sections of Africa, Asia, and Latin America.

Red: WARS OF INTEREST, HIGH RISK AREAS

Blue: WARS OF INTEREST, LOW RISK AREAS

- Democracies are likely to intervene because there may exist an economic interest, for example in strategic raw materials from these areas.
- An example is the oil-rich "Muslim Crescent" of North Africa, the Middle East and South West Asia
- An example is North and South Korea

FIGURE 1.6.3 THE UNSTABLE WORLD WHERE DEMOCRACIES MAY INTERVENE WITH MILITARY FORCE
Chapter 1

AREAS OF THE WORLD CONSIDERED FOR COMBAT MODELS

Klare (1991) has reported that the US military had two main combat models before the break up of the Warsaw Pact, for high intensity and low intensity combat. They envisaged high-intensity conflict in Europe between US/NATO and the Warsaw Pact and low-intensity conflict against guerrillas in Central America. A later model, which has gained higher priority since the break up of the Warsaw Pact is mid-intensity conflict with periodic battles against strongly armed regional forces such as Syria or Iraq.

Klare (1991) reports that mid-intensity conflicts are likely to be rapid-paced and with highly sophisticated weapons. Within the Third World there are large powers which have acquired substantial weapons arsenals and the capability of producing chemical or nuclear weapons, including Argentina, Brazil, Egypt, India, Iran, Iraq, Israel, Pakistan, South Africa, Syria, Taiwan, Turkey, North Korea and South Korea. Saracino (1993) considers that the proliferation of arms sales to warring factions by countries hungry for foreign currency, in particular the US dollar, in which so many deals are made, is an extremely serious issue. Ventor (1993) pointed out that the Somali warlords engaged in what is described as "brutal clan warfare" in Somalia had obtained weapons from several arms producing countries:

- landmines - United Kingdom, CIS.
- small arms and rocket propelled grenades - Russia.
- carbines - Italy, Spain, Portugal, China, Brazil.
- miscellaneous weapons - Israel, South Africa, North Korea, South Korea, France.
Chapter 1

The USA has supplied military aid, arms and technology not just to close allies such as Israel, South Korea and Turkey, but also to other Third World countries such as Iraq and other allies of the former Soviet Union, in order to diminish military dependence on Moscow. Klare (1991) believes that priority should be given at international level to curbing the spread of advanced military technology rather than committing to a strategy which will lead to recurring military conflicts.

1.7 NATO, THE WESTERN EUROPEAN UNION AND THE EC

Membership of NATO has been the foundation of UK national security policy (Defence Committee, Statement of the Defence Estimates, Vol 1, 1991) and has been the major influence on British defence expenditure and therefore on the relationship between the UK defence industry and its major customer, the UK Government. Approximately 95% of the UK defence budget is directed to fulfilling NATO commitments (Forecast International, 1990). Whilst still strongly committed to NATO, the UK has joined the Atlantic Alliance in order to balance the traditional dominance of NATO by the USA and in 1988 the UK took presidency of the Western European Union (WEU).

Since the Conventional Forces in Europe (CFE) negotiations, the political and military changes in former WTO countries, the WEU has become increasingly important in matters of European defence and security policy. Aerospace World (February, 1992, p. 53) describes how following the EC Summit Conference in Maastricht in December 1991 (Treaty on European Union, CONF-UP-UEM 2002/92
AF/UP-UEM/en p.30 to p.35), it was agreed that the WEU will formulate and implement a common European defence policy. The agreement covered:

- The Western European Union has a role as the defence agency of the EC.
- The creation of a central planning office, improved interaction between defence staffs of European countries and improved co-operation in observation, logistics transport, training
- Active consideration by the EC of France's proposal for increased collaboration on arms development and procurement, leading to a European joint weapons procurement agency.

1.8 ARTICLE 223 OF THE TREATY OF ROME

Fedderson and Silva (1992) have described how Article 223 of the Treaty of Rome 1957, which established the European Economic Community, provides exemption from the provisions of the Treaty for the manufacture and trade in armaments, in order to retain national security independence within each member nation of the EC.

There is no co-ordination of defence equipment procurement between the European NATO countries and each of these countries except France relies heavily on defence equipment imports from the USA (Sipri Year Book 1991). The USA defence exporters appear to benefit from Article 223 (Business Europe, 21 April 1986, pp 1-2). Unattributable sources consider it likely that the EC Article 223 may be repealed and the WEU with the influence and support of the EC will become the major instrument in co-ordinating European defence.
The European dependence on USA equipment is shown in Table 1.8 which shows the level of imported USA defence equipment as a percentage of the total equipment procurement by country for the year 1988. The large trade imbalance has been compensated by offset contracts placed by the US suppliers in the importing countries.

**TABLE 1.8  European dependence on usa defence equipment, 1988**

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>DEFENCE EQUIPMENT IMPORTS FROM USA AS % OF TOTAL EQUIPMENT PROCUREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turkey</td>
<td>89%</td>
</tr>
<tr>
<td>Greece</td>
<td>78%</td>
</tr>
<tr>
<td>Denmark</td>
<td>77%</td>
</tr>
<tr>
<td>Norway</td>
<td>64%</td>
</tr>
<tr>
<td>Italy</td>
<td>53%</td>
</tr>
<tr>
<td>Holland</td>
<td>44%</td>
</tr>
<tr>
<td>Portugal</td>
<td>44%</td>
</tr>
<tr>
<td>Spain</td>
<td>41%</td>
</tr>
<tr>
<td>Germany</td>
<td>33%</td>
</tr>
<tr>
<td>Belgium</td>
<td>32%</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>7%</td>
</tr>
<tr>
<td>France</td>
<td>1%</td>
</tr>
</tbody>
</table>

Source: Table generated by present author from data presented in Eurostrategies Report 1991.

The Eurostrategies Report 1991 explains that the European defence industries have directed effort to exporting to the Third World and to the Middle East as they were unable to establish strong market shares in the USA or within Europe.

An estimated 25% by value, approximately $15B, of European defence equipment procurement was imported from the USA in 1988 according to the Eurostrategies Report, 1991 and the European defence equipment exports to the USA are around one twentieth of that value, at $750M in that year. This USA-European trade in
armaments is called the "two-way street" but European industrialists have described
the 20:1 imbalance in armaments trade as a three lane highway in one direction and
a footpath in the other. The Eurostrategies Report, 1991 considers that the American
view is that the high level of defence export to Europe is compensated by the burden
to the US economy of the US military presence in Europe. A European view is that
the high level of US exports is a result of aggressive marketing and US government
Foreign Military Sales and Foreign Military Aid, FMS and FMA, initiatives and the
low level of European exports to the US results from USA protectionism.

Aerospace-World (February 1992, p. 53) reported that a proposal by Germany, the
Netherlands and Belgium at the EC Maastricht Conference in December 1991, called
for the removal of Article 223, but this proposal was not agreed.

The Financial Times (15 October 1991, p. 2) reports that the Bow Group, an
independent Conservative Party think-tank, proposes a single European market in
armaments and this can be achieved within the present terms of the Treaty of Rome
without amendment of Article 223.

NATO has drawn up a document (Electronics Times, 29 October 1992, p. 36)
covering the code of conduct for procurement of arms, which is intended to open up
the military market to free competition thus enabling nations to get the best value
for money. The code is not legally binding and allows exemptions in the case of
essential national imperatives.

Fletcher (1992) has suggested that as the influence of the Western European Union
increases, there may emerge a co-ordinated definable European defence market and in the long term a European procurement agency.

1.9 CONCLUSION

1. The Western and Soviet defence industries had the benefit of largely stable and steadily growing markets for several decades. This was based on the "military balance" and the policy of deterrence between NATO and the Warsaw Pact. There was increasing scale of investment in defence procurement and increasing scale of sophistication in military technology. The relationship between government and industry has traditionally been that between supplier and principal and sometimes only customer, the Ministry of Defence. The relationship began to change in the mid-1980s with the introduction of competitive tendering and the government actively seeking a wider choice of supplier, including foreign suppliers. Similarly the defence industries sought to widen their customer base to include foreign governments.

2. While industrialists are seeing their domestic arms markets decline, commercial pressure is being applied to Government by interest groups wishing to increase arms exports. There has been increased interest in the financial balance of the military trade between countries and trade associations and industrial interest groups are presenting ideas of policies or strategies to create stability in the defence industry and in defence trade.
3. The end of the cold war in 1989 was brought about by diplomatic and political changes in the East and West and the defence industries were faced with a long term decline in domestic and world markets. The break up of the Warsaw Pact and the removal of Soviet control in Eastern Europe has led to an unprecedented level of ethnic violence and civil strife. An example is seen in the violence in the former Yugoslavia. The world has become extremely unstable with over one hundred major armed conflicts in 1989 and an increasing number of countries are developing or purchasing highly advanced weapons systems capabilities including chemical, nuclear and biological weaponry. Third world countries are building up substantial weapons arsenals. The proliferation of arms sales to warring factions by countries hungry for foreign currency, particularly US dollars, is a serious issue and is leading to increased levels of violence.
Chapter 2

Trends in defence technology and military trade
FIGURE 2.1. a and b

The photographs are copies of postcards showing battle zones in World War I. The scenes:

No.725 Les Ruines d'Albert, Somme
No.7222 Eglise de Fontiecourt, Somme
No.1266 English Front, Virgin of Montbauban
No.1255 English front, digging a communications trench through Delleville Wood.

The photographs are shown in order to compare the devastation suffered during the 1914-1918 war, with the low level of damage from precision weapons demonstrated in the Gulf War in 1991 shown in Figures 2.1.c and d.

Postcards from private collection, by permission of Norman Coker.
Chapter 2

1254. **La Virgin of Montauban - The only thing left untouched by shell fire**

1255. **Tommys creasing a communication trench through - Belleville wood**
FIGURE 2.1.c.

The photographs were taken during the Gulf War, 17 January 1991 to 26 February 1991.

The photographs show:

- laser targeting on a strategic bridge at night.
- bridge hit by a laser guided bomb
- a day-time damage assessment photograph showing the destruction of the bridge and the low level of damage to the immediate vicinity.

Photographs by permission of GEC Ferranti Limited.
FIGURE 2.1.d.

The figures show hardened aircraft shelters being targeted and hit by laser guided bombs. The photographs were taken during the Gulf War (17 January 1991 to 26 February 1991). The two bomb damage assessment photographs on the following p. show the damage to the hardened shelters and a low level of damage to the surrounding areas.

Photographs by permission of GEC Ferranti Limited.
2. TRENDS IN DEFENCE TECHNOLOGY AND IN THE ARMAMENTS TRADE

2.1 TECHNOLOGY

Fletcher (1992) has reported that the discussions of a European rapid reaction force are aimed at strengthening the capability to cope with less clearly defined threats than that of the NATO versus Warsaw Pact, where the scope, timing and area of military conflict are not predictable. High technology military equipment is likely to be provided for a rapid reaction force and therefore larger defence industries with the necessary resources or highly specialised industries will benefit from these types of equipment procurement. Kirkpatrick in RUSI (1993) points out that the then current British armed forces faced multi-scenario situations, (and compared their equipment requirements to those of the Victorian times against as wide a range as Red River, Taku forts, desert, jungle, against assegais and Mauser rifles). He concluded that the range of situations required a high level of flexibility and robustness in military organisation and weaponry. Kiely (1990) reported that in the West there is political pressure to minimise civilian casualties in times of conflict. Recently wars involving the West have been conducted under the full glare of the media and therefore high precision weapon systems (Figures 2.1.a, b, c, and d) and stand-off weapons (where the launch platform is out of reach of enemy fire) are politically more acceptable than lower technology systems.

Klare (1991) reports that the USA military funding for weapons and forces will be directed towards strategic mobility, mobile firepower, advanced tactical aircraft,
advanced stand-off missiles, anti-tactical ballistic missiles, command, control, communications and intelligence (C³I) and medium sized combat brigades and divisions.

2.2 TECHNOLOGY FOR SIMPLE OPERABILITY AND EASE OF MAINTAINABILITY

Kiely (1990) reports that the trend towards more complex and higher technology weapons will increasingly be accompanied by an increase in simplicity of operation and maintenance. There are two factors influencing this trend. The first is that the world markets are becoming more important to defence industries and the level of skill in the user and in the maintenance crew will be lower. The second factor is that a consequence of cuts in military expenditure by the United Kingdom and other western countries, is that the numbers of equipment in service and the numbers of personnel in the armed forces will be reduced and therefore the equipment must be user-friendly and highly automated for less manpower, with high reliability and less support-intensive maintenance (Statement on the Defence Estimates 1992).

Whereas the aims of technology have until around 1989 been directed to higher performance, Kiely (1990) considers that technological innovation will be increasingly directed towards simplicity, reliability and low cost.
Chapter 2

CONSEQUENCE OF UNSKILLED OPERATORS IN IMPORTING NATIONS.

Chaisson and Slade (1991) considered that the problem of developing nations not having skilled operators to maintain and use the imported system was either ignored, resulting in the systems rapidly deteriorating and becoming unusable, or was countered by contracting foreign nations to carry out maintenance and operation. In the Gulf area many military systems are supported and maintained by the British military working under contract to the UK Ministry of Defence. The existence of this established support presence brought immediate benefit in operational integration for the allied forces in the Gulf War. Several British defence companies had teams of skilled engineers in Saudi Arabia when the hostilities began and the teams remained in place throughout the Gulf War, enabling equipment upgrades and modifications to be made quickly.

NEW NICHE MARKETS

Kiely (1990) points out that new niche markets are evolving partly due to the world's post cold war situation. He noted the new opportunities for retrofit and upgrading of equipment which results from the a growing emphasis on achieving effective use of existing hardware and facilities rather than automatic replacement by new generation equipment.

Training and simulation equipment has become important for both cost effectiveness and for environmental considerations. Kiely (1990) points out that in general all British Army equipment procurement contracts include training and simulation costs. Flight simulators, which provide pilots experience of flying over enemy terrain, are
useful where environmental and safety considerations restrict low flight training. Other simulators are weapons effect ranges, computer based war games and electronic warfare trainers.

The requirement for treaty verification has provided opportunities for companies with surveillance technologies: seismic monitoring equipment for recording trial explosions, remote sensing satellites, x-ray equipment, tamper-proof seals and tamper-proof tags.

There is increasing need for mine detection and mine clearance and for weapons disposal (Wyatt 1989). Many different types of specialist technologies are exploited to detect the range of explosive devices, from the improvised explosive devices commonly used by small terrorist groups to high technology smart explosives used by the military.

Chaisson and Slade (1990) have considered the military electronics market and their conclusion was that the military environment is continuing to show an increasing dependence on electronics. They predict that the large broadly based defence companies will survive but that medium size defence companies will be eliminated either by being unable to compete against the resources of the major companies or by being acquired by the larger companies. They predict that the smaller niche market companies will survive the future market changes. The principle product areas of military electronics are:

- Command, control, communications and intelligence, C3I, which accounts for
25% by value of the military electronics market,

- Data and signal processing, 18% by value,
- Electronic combat, 14% by value,
- Fire control and integration, 10% by value,
- Miscellaneous, for example testers and simulators, 10% by value,
- Navigation, 7% by value,
- Surveillance and detection, 16% by value.

Chaisson and Slade (1990) consider that there will be steady growth in the surveillance and detection segment of the military electronics market. The prediction for market growth is based on:

1. The extremely short warning times between being targeted by the enemy weapon system and being hit, during which time the evasive action or countermeasures must be deployed and the defensive weapons activated.
2. Signals intelligence is seen as a force multiplier on the military units resources.
3. There are growing paramilitary applications for surveillance and detection, particularly against drug trafficking, smuggling, piracy and slavery for example in the South China Seas. Slade (private communication, 1992) reported that in some named Third World countries, the criminal organisations have more advanced communications, radars and a variety of high performance fast boats (in addition to small wooden fishing boats) than the paramilitary or military forces.
4. Chaisson and Slade (1991) reported that the need for improved electronics surveillance and detection technology and also the need for rapid-response field support for electronics intelligence were demonstrated during the Gulf War, when it was found that the libraries or databases which provide characterisation and classification of hostile radars and enemy signals were inadequate. It was reported by Chaisson and Slade (1991) that most of the hostile radars had been switched to war reserve modes (WARMS) and these required immediate detection, analysis and classification. The updated libraries then had to be incorporated into the electronic intelligence, electronic support measures and radar warning receivers as a matter of extreme urgency.

2.3 NON-LETHAL WEAPON TECHNOLOGY

Aviation Week and Space Technology (7 December 1992) has reported that the requirement for rapid reaction forces and the peacekeeping role of NATO forces has led to the development of non-lethal weapons. The article cites the opinion of US Senate Armed Service Committee Chairman Sam Nunn, that peacekeeping forces equipped with non-lethal weapons have a better chance of maintaining authority and avoiding attack without resorting to the use of lethal weapons. A key to maintaining peace is the avoidance of casualties and hostage-taking which escalate the hostilities. Examples of the application of non-lethal weapons are:

- to disable key electronic equipment
- to blind or burnout the sensors in weapons
- to shut off the power supply to enemy cities
Chapter 2

... to incapacitate enemy personnel.

The article mentions some of the disabling technologies under development or being reviewed at the USA Los Alamos military research laboratories. An acoustic weapon is being developed for protection of buildings and fixed installations and is based on an acoustic generator which produces sound at frequencies and volumes that incapacitate humans or can damage internal organs. An enemy has the choice to flee or to stay and be incapacitated. The availability of such a weapon at the siege of the US embassy in Tehran in 1979 would have helped to delay the siege while an escape was planned or while negotiations took place. Smaller acoustic weapons are being designed for use at critical sites for short periods of time, for example at critical airfields during an enemy's strategic operations.

Another disabling device which is being developed is optical flash equipment which emits a flash of light of sufficiently high intensity to burn-out sensor systems or to temporarily blind personnel. Aviation Week and Space Technology (7 December 1992) has reported that the application of one type of technology for a disabling weapon which was used in the Gulf War against Iraq was discovered by accident. In January 1985, chaff, consisting of small metal strips to blind missile radars, was dropped on an air combat test range in the Pacific off the coast of California. The wind caused the chaff to drift inland to San Diego, the metal strips shorted out the city's power supply and 60,000 people in San Diego were without electricity. During the Gulf War Tomahawk cruise missiles were fitted with carbon fibre filled warheads and targeted at the commercial electricity generating plants which powered Iraq's air
defence computers. Without the computer interfaces the air defence centres had to operate alone making them vulnerable to attack.
FIGURE 2.4.1

The figure shows the world military expenditure over the decade 1981 to 1991. The expenditure is measured in US dollars in 1988 prices and exchange rates.

Source: figure by current author adapted from figure by Wulf (1993).
World military expenditure
Measured at constant 1988 prices, in US Billions dollars.

US Billions Dollars

1,200
1,000
800
600
400
200
0

ALL COUNTRIES
INDUSTRIALISED WORLD
DEVELOPING WORLD


Year
FIGURE 2.4.2

The figure shows the value of imports of major conventional weapons, measured in US billions dollars at constant 1990 prices.

Source: figure by current author from data presented by Anthony et al in the SIPRI Yearbook 1992, p. 308

The grouping of the countries into developing, industrialised and least developed countries according to the SIPRI Yearbook 1992:

The countries of the developing world include India, Saudi Arabia, Iraq, Afghanistan, Egypt, North Korea, South Korea, Israel, Angola, Syria, Thailand, Iran, Pakistan, Taiwan, United Arab Emirates and others.

The countries of the industrialised world include USA, UK, Italy, Japan, Turkey, Spain, Czechoslovakia, Greece, Poland, Germany, C.I.S., Australia, Canada, Netherlands, Bulgaria, France, Norway and others.

The world's least developed countries include Afghanistan, Bangladesh, Botswana, Chad, Ethiopia, Gambia, Guinea, Haiti, Laos, Mozambique, Nepal, Niger, Rwanda, Somalia, Uganda, North Yemen, South Yemen, Yemen and others.
World's imports of major conventional weapons

Measured at constant 1990 prices, in US Billions dollars.
2.4 WORLD MILITARY EXPENDITURE AND ARMAMENTS TRADE

MILITARY EXPENDITURE

Wulf (1993), Deger (1992) and Deger (1993) have discussed the level of the world military expenditure. Figure 2.4.1 shows the world military expenditure measured in US billions dollars over the decade 1981 to 1991. The expenditure data was estimated by Herbert Wulf in terms of 1988 values and exchange rates with the US dollar and using the NATO definition of military expenditure which (as reported by Deger, 1990) includes current and capital expenditure on:

- armed forces, defence departments, government defence agencies, government space agencies.
- paramilitary forces,
- police forces trained and equipped for military action.
- military research and development.
- military tests and evaluation.
- retirement pensions of military forces and civilian staff.
- military aid by the donor country.

Wulf (1993) and Deger (1990 and 1991) reported that the world military expenditure increased steadily from 1989 to 1987 by about +3% per year. The 1987 world military expenditure is estimated at nearly 1000 billion US dollars, which equates to 2 million US dollars per minute (Saracino, 1993). From 1987 to 1991 the world military expenditure has declined by approximately 4% per year. The world decline in military expenditure is dominated by the decline in the military expenditure of the
countries of the industrialised world. The countries of the developing world have maintained a comparatively stable level of military expenditure during the 1981-1991 decade.

Wulf (1993) considered that there were four major factors contributing to a decline in the defence industry:

1. The dismantling of the Warsaw Treaty Organisation and the collapse of the Soviet Union have resulted in the perception of reduced threat. Wulf (1993) considered the resulting level of disarmament and force reduction modest in comparison to the magnitude of the changes. He believed that the reductions were the beginning of a long term downward trend in military spending.

2. Wulf (1993) considers that military budgets have been reduced in real terms and countries have given priority to other economic needs.

3. Wulf (1993) considers that where defence industries see their own domestic markets declining, there will be no viable alternative in attempting to increase export markets. He points out that the level of arms exports is declining.

4. As a result of arms control agreements some countries are offering surplus armaments for export.

MILITARY TRADE

Figure 2.4.2 shows the value of level of imports of major conventional weapons over the period 1982 to 1991. Anthony and Wulf (1990) and Anthony et al (1992) have discussed the status of the world's arms trade in the five year periods up to 1989 and up to 1991 (figure 2.4.3). They report that during the previous decade the value of
the world's trade in major conventional weapons varied from $30B in 1980 to approximately $46B in 1987, the Iran-Iraq War being a major cause of the high volume in 1987. From 1987 to 1991 the world's arms import trade decreased by approximately 18% per year to $22B in 1991. Wulf (1993) reported that although there was significant decline in arms exports, that is the export of completed armaments, there was not a similar reduction in arms production or in dual-use technology. He found that the major arms importing countries were negotiating contractual terms requiring indigenous arms production, the transfer of manufacturing technology and the supply of components and sub-systems.

Anthony and Wulf (1990) and Anthony et al (1992) noted two major trends in the arms trade during the period 1985 to 1991:

- there was steady growth of imports of major conventional weapons by the industrialised countries, to the 1989 level of $16.5B per annum followed by decline.
- in the Third World countries there was a peak in arms imports in 1987, followed by a decline.

2.5 IMPORTS IN THE INDUSTRIALISED WORLD

Table 2.5 shows the leading importers of weapons in the period 1985 to 1989 in the countries of the industrialised world.
TABLE 2.5. Leading importers of major weapons during 1985-1989 in the countries of the industrialised world.

<table>
<thead>
<tr>
<th>COUNTRY IN THE INDUSTRIALISED WORLD</th>
<th>AVERAGE MAJOR WEAPONS IMPORTS, $M PER YEAR, DURING 1985-1989</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Japan</td>
<td>2111</td>
</tr>
<tr>
<td>2. Czechoslovakia</td>
<td>1056</td>
</tr>
<tr>
<td>3. Spain</td>
<td>1030</td>
</tr>
<tr>
<td>4. Turkey</td>
<td>950</td>
</tr>
<tr>
<td>5. Poland</td>
<td>930</td>
</tr>
<tr>
<td>6. Canada</td>
<td>682</td>
</tr>
<tr>
<td>7. Greece</td>
<td>623</td>
</tr>
<tr>
<td>8. German Democratic Republic</td>
<td>592</td>
</tr>
<tr>
<td>9. Australia</td>
<td>591</td>
</tr>
<tr>
<td>10. Netherlands</td>
<td>545</td>
</tr>
<tr>
<td>11. USSR</td>
<td>462</td>
</tr>
<tr>
<td>12. Bulgaria</td>
<td>415</td>
</tr>
<tr>
<td>13. Hungary</td>
<td>372</td>
</tr>
<tr>
<td>14. Federal Republic of Germany</td>
<td>369</td>
</tr>
<tr>
<td>15. Yugoslavia</td>
<td>328</td>
</tr>
<tr>
<td>Other industrialised countries</td>
<td>2310</td>
</tr>
<tr>
<td>Total</td>
<td>13,365 M$ per year</td>
</tr>
</tbody>
</table>

Table by current author, adapted from data by Anthony and Wulf (1990)

Anthony and Wulf reported that the steady overall growth in weapons imports in the industrialised world during the period 1985 to 1989 was due to specific military developments in a few countries. The trends reported were as follows:


There were major military modernisation programmes in Greece, Spain, Turkey and Norway.

3. In the Pacific Rim, Japan and Australia have increased the weapons imports
and at the same time have expanded their domestic defence industrial bases.

4. Kiely (1990) has pointed out that non-aligned European countries, Albania, Austria, Finland, Ireland, Sweden, Switzerland and the former Yugoslavia, continue to be small spenders and therefore have little impact on overall trends in defence imports. Austria was reported as developing guided missile industrial capability in 1990 and Sweden is a major exporter of military equipment.

2.6 MILITARY IMPORTS IN THE THIRD WORLD

During the period 1985 to 1991 reviewed by Anthony and Wulf (1990) and by Anthony et al (1992) the level of weapons imports by Third World countries peaked in 1987 and then declined to 1991. In the Middle East there was very high military spending in the years of the Iran-Iraq war and during the build-up period prior to the Iraq invasion of Kuwait. In South Asia weapons imports increased substantially in the period 1985 to 1989. For example India, the world's highest military importer, doubled its military imports from $1876M per year in 1985 to $3819M per year in 1989, the main suppliers being Federal Republic of Germany, Sweden, United Kingdom and the USSR. Table 2.6 shows the Third World countries leading importers of major weapons during the period 1985 to 1989.
TABLE 2.6 Third world countries leading importers of major weapons during the period 1985 to 1989.

<table>
<thead>
<tr>
<th>COUNTRY IN THE THIRD WORLD</th>
<th>AVERAGE LEVEL OF MILITARY IMPORTS DURING THE PERIOD 1985 TO 1989, $M PER YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. India</td>
<td>3469</td>
</tr>
<tr>
<td>2. Iraq</td>
<td>2397</td>
</tr>
<tr>
<td>3. Saudi Arabia</td>
<td>1752</td>
</tr>
<tr>
<td>4. Syria</td>
<td>1175</td>
</tr>
<tr>
<td>5. Egypt</td>
<td>1159</td>
</tr>
<tr>
<td>6. North Korea</td>
<td>1055</td>
</tr>
<tr>
<td>7. Afghanistan</td>
<td>922</td>
</tr>
<tr>
<td>8. Angola</td>
<td>743</td>
</tr>
<tr>
<td>9. Libya</td>
<td>637</td>
</tr>
<tr>
<td>10. Taiwan</td>
<td>589</td>
</tr>
<tr>
<td>11. Iran</td>
<td>588</td>
</tr>
<tr>
<td>12. Pakistan</td>
<td>583</td>
</tr>
<tr>
<td>13. South Korea</td>
<td>558</td>
</tr>
<tr>
<td>14. Israel</td>
<td>537</td>
</tr>
<tr>
<td>15. Thailand</td>
<td>372</td>
</tr>
<tr>
<td>Others</td>
<td>4657</td>
</tr>
<tr>
<td>Total</td>
<td>21,197 $M per year</td>
</tr>
</tbody>
</table>

Table by present author adapted from data presented by Anthony and Wulf (1990)

According to Anthony and Wulf (1990), Anthony et al (1992), and Wulf (1993) the decline in military imports by the developing nations and the Third World countries was associated with the following factors:

1. Less hard currency has been available to some Third World countries. Oil prices declined resulting in less funds being available to the countries of OPEC, the Organisation of Petroleum Exporting Countries.

2. Arms imports dropped considerably when several notable wars ended, for example the war between Iraq and Iran and the war between South African and Cuban/Angolan armed forces in Namibia.

In contrast the arms imports in Afghanistan increased significantly as the
fighting escalated.

3. Arms exports of the former USSR fell dramatically from $17.7B in 1987 to $3.9b in 1991.

4. Wulf (1993) points out that a number of developing countries and Third World countries are building a domestic arms industry. In the 1970's the domestic activity was largely limited to assembly of supplied kits but in the 1990's there are expanding military electronics industries in the Third World. The domestic industrial military capability of Iraq has been reported in great detail and the extent of their capability surprised western observers.

OFFSETS

Horvath (1993) has described how several countries make military purchases conditional on securing offset contracts, whereby the supplier is committed to attracting investment into the buyers country, or arranging placement of purchase orders into the buyer country. Offer (1993) described in the Ministry of Defence DESO Newsletter (February 1993) the A1 Yamamah arms contracts with Saudi Arabia where British Aerospace was named as prime contractor. The A1 Yamamah agreement includes offset arrangements to provide investment in Saudi Arabia.

Two further examples of offset deals mentioned by Horvath (1993) were announced at the IDEX military equipment exhibition in Abu Dhabi in February 1993, where the United Arab Emirates announced a $4B contract to purchase the French GIAT Industries army recovery vehicles and 436 Leclerc main battle tanks and a $300M contract to the USA company, Westinghouse, for an air defence command, control
and communication system and the contractors are committed to generating investment in the UAE worth 60% of the value of the contracts.

Horvath (1993) considers that large diversified companies will be better placed than small defence companies to deal with offset investment requirements.

LICENCE FOR IN-COUNTRY MANUFACTURE

C'Halloran in the BBC documentary programme, Panorama, 22 March 1993, reported that the list of arms exporters is including new countries such as South Africa (long range artillery systems), Slovakia and Iran (weapon systems, boats). Kiely (1990) has summarised how some countries are becoming newly established as arms exporters and Miggiano (1992) and Anthony (1992) have reported the expansion and upgrading of the arms industry in countries such as Australia, China, Japan, South Korea and Taiwan.

- Egypt has developed a range of as yet unsophisticated weaponry and is reportedly aspiring to become a major arms supplier to the Muslim world. Egypt has negotiated licensed production of UK anti-tank missiles, USA M-1 Abrams main battle tanks, USA surveillance radars and USA AIM-9P air-to-air missiles.

- China is developing a range of weapon systems and electronic warfare equipment, air-to-air missiles and also anti-aircraft missiles developed from the Soviet SA-7 missile. China has licensed production of French AS-365 helicopters and Israeli PL-8H air-to-air missiles.

- Brazil has limited production of air-to-air missiles and has licensed production
of the Austrian GHN-45 155mm towed howitzer and the German SNAC-1 nuclear powered submarine.

Indonesia has licensed production of the French AS-332 helicopter, the German NBo-105 helicopter, the German PB-57 patrol craft, the Spanish CN-212 transporter and the UK Hawk trainer aircraft.

2.7 THE LEADING EXPORTERS OF MAJOR WEAPONS

Anthony and Wulf (1990) have surveyed the leading exporting countries of major weapons over the years 1985 to 1989. They found that the United States and the Soviet Union dominated the military world trade, between them accounting for 71% of the world's total military trade.

Table 2.7 shows the leading exporters of major weapons in the period 1985 to 1989.
TABLE 2.7 Leading exporters of major weapons in the period 1985 to 1989

<table>
<thead>
<tr>
<th>EXPORTING COUNTRIES</th>
<th>AVERAGE LEVEL OF MILITARY EXPORTS DURING THE PERIOD 1985 TO 1989, $M PER YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. USSR</td>
<td>13242</td>
</tr>
<tr>
<td>2. USA</td>
<td>10572</td>
</tr>
<tr>
<td>3. France</td>
<td>3160</td>
</tr>
<tr>
<td>4. UK</td>
<td>1542</td>
</tr>
<tr>
<td>5. China</td>
<td>1372</td>
</tr>
<tr>
<td>6. F.R.Germany</td>
<td>1003</td>
</tr>
<tr>
<td>7. Czechoslovakia</td>
<td>532</td>
</tr>
<tr>
<td>8. Italy</td>
<td>415</td>
</tr>
<tr>
<td>9. Sweden</td>
<td>375</td>
</tr>
<tr>
<td>10. Netherlands</td>
<td>351</td>
</tr>
<tr>
<td>11. Brazil</td>
<td>277</td>
</tr>
<tr>
<td>12. Israel</td>
<td>237</td>
</tr>
<tr>
<td>13. Spain</td>
<td>222</td>
</tr>
<tr>
<td>14. Canada</td>
<td>221</td>
</tr>
<tr>
<td>15. Egypt</td>
<td>154</td>
</tr>
<tr>
<td>Others</td>
<td>886</td>
</tr>
<tr>
<td>Total</td>
<td>34,563 $M PER YEAR</td>
</tr>
</tbody>
</table>

Table by present author from data presented by Anthony and Wulf (1990)

The USSR maintained steady world leadership in the export of weapons during the period 1985 to 1990 reported by Anthony and Wulf (1990). The Soviet Union accounted for more than half the imports into the Third World countries. Afghanistan, India, North Korea, Iraq, Iran, Angola, Ethiopia and Nicaragua were major importers of weapons from the former USSR.

The German Democratic Republic was a major source of technical military assistance to the Third World and particularly to Cuba, Ethiopia (200 type T-55 tanks), India, Iraq (trucks, radar maintenance), Iran (refurbished MIG-21 fighter aircraft), Kampuchea and Vietnam.

For the USA the value of weapons exports to Third World countries decreased and
exports to the industrialised world increased during 1985 to 1989. The opposite trend was seen for the USSR. The main weapons importer from the USA was its ally, Japan. Other traditional customers of the USA are Australia, Germany, Greece, Netherlands, Spain, Turkey, Brazil, South Korea, Pakistan, Taiwan and Thailand. Anthony and Wulf (1990) reported that the reducing level of USA sales to the Middle East were due to concern over the security of Israel.

Anthony and Wulf (1990) reported that over 60% of British arms exports were to the Third World during the 1985-1989 period under review, with these exports increasing slightly on aggregate. The UK military exports to the industrialised world decreased during 1987 and 1988 but recovered to a slightly lower figure than at the start of the 5 year period reviewed in Anthony and Wulf (1990).

Anthony and Wulf (1990) reported that Western European countries were increasing arms exports to the Middle East during 1985 to 1989. They found that there was a trend where countries which had previously been supplied by the USA and by the USSR were seeking supply from Western Europe.

Anthony et al (1992) reported that the world total exports of major conventional weapons has reduced from $46B in 1987 to $22B in 1991 which represents a reduction by about 50% over four years. The trend was dominated by the dissolution of the Soviet Union and the sharply decreased level of military exports from the USSR. The USSR had been the largest single supplier of major conventional weapons over the decade 1980 to 1990.
PROSPECT OF FACING ALLIES' EQUIPMENT IN COMBAT

Chaisson and Slade (1991) considered that a major disadvantage to the west in relying on exports to reinforce the home defence industry was the prospect of facing one's own equipment or the equipment of one's allies in combat. The prospect became reality in the Falklands conflict when British forces faced the Argentinean forces armed with the Exocet missile, supplied by France (Forecast International, 1990).

The list of user countries of one particular anti-ship missile, the Exocet missile, is an indication of the geographical spread of western high technology weapons:

- Abu Dhabi
- Argentina
- Bahrain
- Belgium
- Brazil
- Brunei
- Cameroon
- Chile
- Colombia
- Ecuador
- Egypt
- Gabon
- Germany
- France
- Greece
- India
- Indonesia
- Iraq
- Ivory Coast
- Kuwait
- Libya
- Malaysia
- Morocco
- Nigeria
- Oman
- Pakistan
- Peru
- Philippines
- Qatar
- Korea
- Saudi Arabia
- Singapore
- South Africa
- Thailand
- Tunisia
- UK

plus four other unidentified countries.

Western military equipment and western military technology can be unlawfully transferred to a third nation by the purchasing country.

The Patriot MIM-104 is a long range land-to-air missile developed by the USA.
company Raytheon and it is reported that Israel has a programme to procure 700 Patriot missiles between 1991 and 1998. Dickerson (1992) reported information leaked to the US news media that China had purchased MIM-104 Patriot missile technology from Israel, an accusation which the Israeli and USA governments have denied. Israel has become a leading source of advanced technology to China, particularly since the Tiennanmen Square massacre in 1989. The Patriot is used in an air defence role to intercept incoming ballistic missiles. China develops an M-series of ballistic missiles and it is believed that China will use knowledge of Patriot technology to strengthen the M-series against defensive counter-measures. It was considered that Israel received information on China's M-series in return as part of the agreement.

Dickerson (1992) has also reported other alleged transfers of technology by Israel:

- United States technology assistance was provided to Israel to develop Israel's now cancelled Lavi fighter aircraft programme. It has been alleged that Israel has passed on technology from the programme to China.
- It is alleged that USA technology was used in developing Israel's Python air-to-air missile and that Israel has assisted China in the development of its PL-8 air defence system.
- It is alleged that Israel and South Africa co-operate in the development of armaments with technology transfer in both directions. It is alleged that Israel has supplied technology from its Arrow anti-tactical ballistic missile programme and South Africa has supplied strategic materials to Israel.
2.8 ARMS PRODUCTION

Anthony (1993) reports that whilst there exists quantitative data on the value of the world's arms exports, there is no comparative data on the value of arms production. Anthony (1993) cites Ross (1989) who classified countries in terms of their activities in arms production and according to the value of their armaments exports and the classifications or "tiers" are shown in Table 2.8.1.

### TABLE 2.8.1 Classification of countries according to production of major weapons

<table>
<thead>
<tr>
<th>CLASSIFICATION</th>
<th>COUNTRIES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FIRST TIER</strong></td>
<td>USA</td>
</tr>
<tr>
<td>Full range of arms production capability under national control.</td>
<td>The former USSR would have been included in this first tier.</td>
</tr>
<tr>
<td><strong>SECOND TIER</strong></td>
<td>China, France, Germany, Italy, Japan, Sweden, United Kingdom</td>
</tr>
<tr>
<td>Countries which could produce the full spectrum of arms but choose not to for political/economic reasons.</td>
<td></td>
</tr>
<tr>
<td><strong>THIRD TIER</strong></td>
<td>Argentina, Brazil, Chile, Egypt, India, Indonesia, Israel, Pakistan, Singapore, South Africa, South Korea, Taiwan.</td>
</tr>
<tr>
<td>Countries having significant arms industries but which are not able to produce the full spectrum of arms.</td>
<td>Australia, Canada, Greece, Poland, Spain, Turkey, Russia, Ukraine.</td>
</tr>
<tr>
<td></td>
<td>Iran, Iraq and North Korea have announced plans to develop arms industries and have made significant investment to do so.</td>
</tr>
<tr>
<td><strong>FOURTH TIER</strong></td>
<td>Rest of world.</td>
</tr>
<tr>
<td>Countries with minimal arms production.</td>
<td></td>
</tr>
</tbody>
</table>


Anthony (1993) was unable to include a chapter on Canada in time for publication of his book and the work has omitted countries such as Malaysia and the Philippines which are building an indigenous defence industry. Anthony (1993) concluded that self-sufficiency in arms production was not an achievable goal for most countries. Only the United States of America is in the first tier with the entire range of arms production.
production under national control. Before the break up of the USSR, the USSR would have been included in the first tier. Anthony (1993) cited Colin Powell, Chairman of the US Joint Chiefs of Staff who considered that it would take at least 20 years for Russia to rebuild its arms production capacity to the levels achieved in the mid-1980s. The second tier of countries are those which have the technical capability to support the production of the full range of arms equipment, but choose not to do so based on political or economic reasons. The third tier countries are those which have significant arms production capabilities but lack the capability to produce the full range of armaments. The fourth tier countries are those with minimal or zero arms production activities.

DEVELOPING DEFENCE INDUSTRIAL NATIONS

Krause (1992) reported that the three forces which play a role in shaping the patterns of military innovation and production and the subsequent transfer of arms and skill resulting in the flow of military technology are wealth, power and war. Krause's study (Krause, 1992) which covered centuries and included the historical evolution of international arms trade, found that none of the three forces were of higher importance than the other two over the medium term. The force of wealth was described in terms of economic forces that shape the production and distribution of goods within and between nations. The force of power was a result of the pursuit of power by nations which resulted in attempts to change their positions in arms production and in arms transfer. The force of war is the catalyst of necessity for military innovation and production which occurs before, during and after major
conflicts. Krause (1992) concluded that there were features of the arms trade which were persistent throughout the epochs of history: 1) economic, political and military forces were the driving forces in directing arms trade, and 2) the existence of tiers of producers with different levels of capability in arms manufacture. Kraus (1992) also found contrasts in contemporary arms transfers and those of previous epochs: 1) the use of arms supply as a positive tool of foreign policy rather than as a negative tool such as an embargo, and 2) the emergence of transnational arms production.

Forecast International (1990) and Chaisson and Slade (1991) report that countries, for example those of the Pacific Rim, with emerging economies and a growing technical base are building indigenous arms production capabilities and are no longer willing to accept Western equipment without some form of counter-trade. In 1965 Indonesia, Taiwan and Singapore had no indigenous production and no licensed production of major weapon systems and relied 100% on imported major weapons. In 1990 Indonesia imported 44% of its major weapons (indigenous production 41%, licensed production 15%), Taiwan imported 20% (indigenous production 50%, licensed production 30%) and Singapore imported 45% (indigenous production 34%, licensed production 20%) according to Anthony (1993). The countries with emerging economies want to "catch up" with western Europe and North America and believe they have the bargaining edge to do so.
FIGURE 2.8.2

This is a figure of the values of major weapons procurement by twelve "Third Tier" countries during the period 1965 to 1990 and shows the values of major weapons procurement by i) indigenous production, ii) licensed production, iii) direct imports and iv) total weapons procurement. The third tier countries are those countries which have significant arms production capabilities, but lack the capability to produce the full range of armaments. The figure represents the data from twelve third tier countries:

Argentina  Brazil  Chile  Egypt  India  Indonesia
Israel  Pakistan  Singapore  South Africa  South Korea  Taiwan

Figure by current author from data presented by Anthony (1993)
Estimated Values of Major Weapons Procurements by Twelve "Third Tier" Countries

- Indigenous production
- Licensed production
- Direct imports
- Total of weapons proc.
Anthony (1993) investigated the indigenous production, the licensed production and the direct imports of twelve countries within the third tier: Argentina, Brazil, Chile, Egypt, India, Indonesia, Israel, Pakistan, Singapore, South Africa, South Korea and Taiwan. His observations are summarised:

1. India and Israel have the largest weapons manufacturing activity of the group.

2. The value of weapons production began to grow in the late 1970s in Brazil and South Korea and in the mid-1970s in South Korea and Taiwan.

3. In Latin America, in countries such as Argentina and Brazil, there was considerable growth in the arms industries, but growth is not sustained in the 1990s. There is sharply declining volume of arms production in Argentina in the 1990s.

4. The value of major weapons production is rising in India, Indonesia, South Korea and Taiwan and all four countries produce a wide range of weapons in preference to limiting production to a few product areas.

5. Egypt and Israel have a stable level of arms production. Israel has been able to improve and upgrade high technology systems it has licensed or imported and has re-exported the modifications to the country of origin.

6. All the countries have used licensed production.

Figure 2.8.2 shows the values of weapons procurement for twelve third tier countries from 1965 to 1990, using data estimated by Anthony (1993). During the period reviewed by Anthony (1993) the total major weapons procurement has increased, as has licensed and indigenous production. The level of the value of defence imports increased from 1965 to 1987, with peaks in the years 1967, 1973, 1977, 1982, 1987.
The value of defence imports has dropped since the last peak in 1987 and in 1990 for the first time, the value of indigenous production became higher than the value of defence imports.

**MOTIVATION FOR DEVELOPING AN INDIGENOUS DEFENCE INDUSTRY**

A major reason for developing and maintaining an indigenous arms manufacturing capability is that reliance on another country can result in the supplier country dictating or influencing the foreign policy of the recipient country and the fear that at a time of crisis the supplier may not provide equipment or equipment support.

Anthony (1993) listed examples of countries increasing indigenous arms capability following instances of arms embargoes by important suppliers:

- Iran (1979)                        Iraq (1979)          Pakistan (1965)
- South Africa (1963)                Turkey (1974)

Egypt and Israel were strongly affected by the 1950 Tripartite Declaration Regarding Security in the Near East where the continuation of arms supplies from the UK, USA and France was conditional on the recipients behaviour.

Following the personal intervention by the President of the United States, Jimmy Carter, to block the supply of F-5G fighter aircraft to Taiwan, Taiwan directed extra effort to building its own fighter aircraft and built its first jet aircraft in 1982.

Anthony (1993) noted a second major disadvantage of reliance on imported weapon
systems, is that at a time of crisis the supplier may choose to pass on confidential information about the weapon system performance to the enemy. An example of this was seen in the Falklands crisis (Eddy et al, 1982) in the willingness of France to provide full details to the UK of the performance of the French equipment supplied to Argentina, the Exocet anti-ship missile and the Etendard attack aircraft. France also provided Mirage fighter aircraft similar to the Argentinean Mirages for practice air-to-air combat targeting by RAF Harrier pilots.

The US Congress Office of Technology Assessment (1991) reviewed the criteria necessary and the methods used by developing countries to acquire an indigenous defence industry. The report concluded that the motivation for possessing an indigenous defence industry was based on strategic, political and economic considerations:

- **Strategic motivation**
  - Improved self-reliance
  - Security of supply
  - Arms race

- **Political motivation**
  - Regional power aspirations

- **Economic motivation**
  - Potential cost reduction
  - Potential foreign exchange earnings through exports
  - Technology spin-off into non-defence industry
## FACTORS AFFECTING ABILITY TO ESTABLISH AN INDIGENOUS DEFENCE INDUSTRY

The Office of Technology Assessment (1991) report outlined four main factors which influenced the ability of developing countries to establish an indigenous defence industry:

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sufficient finance</td>
<td>Investment for manufacturing, Investment for R&amp;D centres, Investment for imports, Domestic defence procurement budget</td>
</tr>
<tr>
<td>Diversified domestic industries</td>
<td>Manufacturing capability in sectors such as steel, metallurgy, machining, electronics.</td>
</tr>
<tr>
<td>Scientific and educational level</td>
<td>Educational level of the workforce, Status of scientific and educational institutions</td>
</tr>
<tr>
<td>State involvement</td>
<td>Direct state ownership of defence industry to ensure viability, Fiscal and trade incentives to reduce costs to domestic defence industries.</td>
</tr>
<tr>
<td>Access to export markets</td>
<td>Access to export markets is particularly important where the domestic defence procurement budget is insufficient to ensure the economic viability of the domestic defence industry.</td>
</tr>
</tbody>
</table>
Chapter 2

PROCESS TO ESTABLISH AN INDIGENOUS DEFENCE INDUSTRY

The Office of Technology Assessment (1991) reported that most of the developing defence industrial nations have pursued a common process to achieve an indigenous defence industry. Initially domestic production is limited to component manufacture and then to assembly under licence of less advanced equipment, while higher technology systems continue to be imported. As the industrial base becomes more capable, in-country design and production of weapon systems are introduced whilst continuing to rely on imported high technology products.

The Office of Technology Assessment (1991) report concluded that licensed production was very common in developing defence industries and covered the manufacture of components, subassemblies and complete weapon systems.

The second most frequently used method to acquire defence technology was through joint venture and teaming arrangements, covering development and production, with companies of the leading defence industrialised nations, for example from USA or Europe and also to a lesser extent with companies from other developing defence industrial nations such as Brazil and Australia.

The Office of Technology Assessment (1991) report pointed out that since 1986 joint venture and teaming arrangements had been extended to cover the earlier stages of research and pre-development and that companies were collaborating on the design, production and the application of advanced military technology. It was noted that these ventures were restricted to the relatively advanced arms producers such as
Brazilian defence companies.

The Office of Technology Assessment (1991) report described how offset arrangements for developing nations have become more common since the early 1980s. The most common offset arrangement involves the purchasing country in the manufacture and supply of components for the weapon system being purchased. It is often the case that the supplier provides training and technical production data to the developing country. The experience gained through offset deals often leads to the more advanced stage of licensed production and eventually to indigenous development.
2.9 CONCLUSIONS

1. The Third World and the emerging nations have been equipped largely with the products of relatively few nations, mainly the former USSR, USA, France, UK, China and Federal Republic of Germany. In recent years the level of defence imports in the Third World countries has steadily decreased to $12.3B per annum in 1991. About 56% of the world's exports of military equipment are into the Third World countries. A large number of Third World countries will only enter into military equipment purchases if the supplier provides offset and technology transfer arrangements.

2. The Third World countries are emerging as manufacturers and exporters of military equipment and military technology in the Third World is becoming increasingly sophisticated.

3. In the industrialised world the value of defence imports represents about 44% of the world's defence imports and the level has decreased to around $10B per annum in 1991. The level of high technology being demanded in several types of major weapon systems favours large suppliers with substantial technology resources, or specialist companies with capabilities in niche technologies. Companies wishing to gain access to specialist technologies in other organisations can gain those technologies in a realistic timescale by mergers, acquisition or by joint venture.

4. Countries such as those in the Pacific Rim with emerging economies and a
growing technology base, are no longer willing to accept western equipment without some form of counter trade. They want to "catch up" with Europe and North America and believe they have the bargaining edge to do so. Supplier countries are being asked to enter into technology transfer agreements, offset and counter trade and technical assistance in setting up in-country manufacture.
Chapter 3

The impact of defence cuts
Chapter 3

3. IMPACT OF DEFENCE CUTS

3.1 IMPACT ON THE ECONOMY

PAYBACK FROM THE DEFENCE INDUSTRY TO GOVERNMENT

Smith (1993) reported that following initial defence procurement contracts, the British Government had achieved a remarkably high return in terms of values of export levels and income tax revenue.

- The UK government invested £1B in the 1970s on the British Aerospace Hawk trainer and ground attack aircraft and the resulting export sales have been valued at £12B and the estimated taxes and other revenues are estimated at £5B.
- The £12.5B investment dating from the 1970s in the Tornado aircraft has resulted in exports to Saudi Arabia valued at £35B. The estimated value of tax revenue to the UK is £11B.
- It was predicted that the European Fighter Aircraft will produce UK tax revenues around £11B.

Smith (1993) concluded that major international defence programmes are highly remunative to the nation and that no other manufacturing industry was comparable in the scale of economic return and benefit. Sir John Weston in RUSI (1993) pointed out that the British Government had no mechanism which allowed the economic benefit to the nation to be considered in the defence procurement process.
The figures shown above by Smith (1993) are for specific major programmes, i.e. for specific aircraft. To compare the level of arms export sales to the UK MOD investment in general equipment procurement it is possible to examine the MOD Defence Export Services figure (Thomas, 1993) for 1992:

£4.5B for defence equipment exports from the UK, 1992

£9.3B for estimated MOD UK defence equipment procurement, 1991/2

THE PEACE DIVIDEND

There are several sources such as Deger (1981), Dunne and Smith (1983), Hartley and Hooper (1987) which consider that military expenditure imposes a substantial burden on the nation and that reduced military expenditure will contribute to the "Peace Dividend" of higher economic growth.

The trade union discussion document, Defence Employment Briefing (March 1992) calculated a predicted peace dividend for the UK as 30,550 million pounds over the ten year period from 1990 to 2000.

The calculated peace dividend is shown in Table 3.1.
### TABLE 3.1 Peace dividend

<table>
<thead>
<tr>
<th>YEAR</th>
<th>PREDICTED DEFENCE BUDGET, MILLIONS POUNDS (1)</th>
<th>GDP DEFLATOR (2)</th>
<th>LEVEL FUNDING TO 1990-91 EQUIVALENT (3)</th>
<th>PEACE DIVIDEND (4) MILLIONS POUNDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990-91</td>
<td>21,800</td>
<td>-</td>
<td>21,800</td>
<td>-</td>
</tr>
<tr>
<td>1991-92</td>
<td>22,850</td>
<td>8.5 %</td>
<td>23,650</td>
<td>800</td>
</tr>
<tr>
<td>1992-93</td>
<td>24,180</td>
<td>7.0 %</td>
<td>25,310</td>
<td>1,130</td>
</tr>
<tr>
<td>1993-94</td>
<td>24,520</td>
<td>4.5 %</td>
<td>26,450</td>
<td>1,930</td>
</tr>
<tr>
<td>1994-95</td>
<td>24,800</td>
<td>3.8 %</td>
<td>27,450</td>
<td>2,650</td>
</tr>
<tr>
<td>1995-96</td>
<td>25,350</td>
<td>3.0 %</td>
<td>28,275</td>
<td>2,925</td>
</tr>
<tr>
<td>1996-97</td>
<td>25,900</td>
<td>5.0 %</td>
<td>29,690</td>
<td>3,790</td>
</tr>
<tr>
<td>1997-98</td>
<td>26,450</td>
<td>5.0 %</td>
<td>31,175</td>
<td>4,725</td>
</tr>
<tr>
<td>1998-99</td>
<td>27,000</td>
<td>5.0 %</td>
<td>32,730</td>
<td>5,730</td>
</tr>
<tr>
<td>1999-2000</td>
<td>27,500</td>
<td>5.0 %</td>
<td>34,370</td>
<td>6,870</td>
</tr>
<tr>
<td>TOTAL PEACE DIVIDEND (5)</td>
<td></td>
<td></td>
<td></td>
<td>30,550</td>
</tr>
</tbody>
</table>

Note 1. Defence budget figures up to the year 1994-95 are taken from the 1991 Autumn Statement. After that date the figures are based on approximately equal cuts resulting in a 20% cut in real terms on the 1990-91 figure by 1999-2000. This figure is based on a projection made by UBS Phillips and Drew (Financial Times 23 July 1990).

Note 2. The GDP deflator figures shown up to 1994-95 are taken from the 1991 Autumn Statement. From 1996 to 2000 a notational 5% figure is used.

Note 3. The level funding figures represent the 1990-91 defence budget maintained in real terms.

Note 4. The "dividend" for each year is calculated as the level funding figure for that year (column 3) less the predicted cash figure (column 1).

Note 5. The total dividend over the ten year period 1990 to 2000 is calculated as 30.55 billion pounds, which the source equates to 21.9 billion pounds at 1990-91 values. This compares to the widely reported cut of 17 billion pounds sought by the MOD Procurement Minister, Alan Clark in June 1990, prior to the Options for Change announcement. The grand total is therefore seen as a realistic figure.


An example of a "Peace Dividend" often quoted is the economic growth in Japan,
where the constitution imposed at the end of World War II required that military expenditure be limited to a maximum of one per cent of its GNP. Dunne and Smith (1983) have considered a reduction in UK military expenditure from 5% to a European average of 3% of GDP, if matched with a compensating increase in public expenditure would result in increased employment and improved economic growth.

A contrasting view was expressed by Chan (1985), who surveyed several studies into the impact of defence spending on the economy. He found that there was no general agreement in the studies and reported significant variations between data sources for the same countries in the same time periods. The USA did not appear to benefit from a peace dividend at the end of the Vietnam war according to Benoit (1973a) who points out that the 1969-1971 recession in the USA was in fact blamed on the US withdrawal from the Vietnam war and the resultant decrease in defence spending. Defence cuts after the Vietnam war were viewed with trepidation by the US defence industry. Peet, Max and Bengston (1965) in a Battelle Report had warned of 73% job cuts in the defence electronics sector and made recommendations on programmes of readjustment which should be made to manage the effects of the cut-backs. Benoit (1973a) considered that the 1969-71 recession was caused by the failure of the US government to manage the decrease in defence spending and failure to implement a compensatory programme to stimulate demand. Benoit (1973b) analyzed the economic growth and defence expenditure of forty-four developing countries and concluded that it was not possible to associate high defence expenditure with lower economic growth.
3.2 IMPACT ON INDUSTRY AND EMPLOYMENT

A major and instantaneous impact of defence cuts on the defence industry is the reduction in orders and ensuing loss of jobs. The IPMS union released figures showing that nearly 95,000 or one-sixth of the UK's 570,000 defence jobs were lost during the eighteen months from mid-1990 to end 1991 (Electronics Times, 16 January 1992) and a further 20,000 civil service jobs were expected to be lost over the following three years. The SIPRI Yearbooks detail how there have been previously reductions in UK military expenditure and the defence industry has responded to the changes, e.g. after World War II, after the Korean War, after HMG's Defence Reviews 1957, 1965-68, 1975, 1981 and in the period 1985 to 1989.

Some companies have tried to sell their defence businesses, for example Thorn EMI tried to sell its defence arm business in 1990 (Electronics Times, 16 January 1992, p. 11). In 1992 the EC commissioned a study by the Economists Advisory Group Ltd (1992) on the impact of changes in defence expenditure and on the dependence of the regions within the EC on defence activities and their vulnerability to reductions in defence spending. The report concluded that past trends were unlikely to be a reliable guide to the future as defence policy and defence spending were changing. They cited data from the SIPRI Yearbook 1991 which showed that over two decades from the early 1970s to the late 1980s the level of defence spending as a percentage of the GDP, in the European Community had declined from 3.7% to 3.3%. Real growth in defence spending had stagnated in the late 1980s to a level of about 128 billion ECU and is predicted to fall from 1991 to 1995 by 10% and by
at least 25% by the year 2000. The study considered regional dependence on defence expenditure as the share of the labour force in that region which is directly employed in defence, either in the defence industry or in the military or in both categories. Any region was assessed as being dependant where the level of defence employment was at least twice the average for the EC. Table 3.2.1 shows the average defence related employment figures for the EC.

**TABLE 3.2.1 Average defence employment within the EC**

<table>
<thead>
<tr>
<th></th>
<th>NUMBER OF PERSONNEL EMPLOYED</th>
<th>NUMBER OF PERSONNEL AS A % OF TOTAL WORKFORCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUMBER DIRECTLY EMPLOYED IN THE DEFENCE INDUSTRY</td>
<td>680,000</td>
<td>0.55 %</td>
</tr>
<tr>
<td>NUMBER EMPLOYED BY THE MILITARY</td>
<td>2,300,000</td>
<td>1.87 %</td>
</tr>
<tr>
<td>NUMBER EMPLOYED IN DEFENCE INDUSTRY AND IN MILITARY</td>
<td>3,000,000</td>
<td>2.41 %</td>
</tr>
</tbody>
</table>

Source: table generated by present author from data presented by Economists Advisory Group Ltd (1992)

It was established that within 183 regions of the EC there were 19 regions which were employment-dependent on the defence industry. Four other regions were identified as having above average defence industry employment. The 23 regions employ over one half of the defence industrial workforce. 32 regions were found to be dependent on employment by the military and 24 regions were dependent on total
defence related activity. Other areas outside the dependent regions were also identified.

It was found that the largest defence companies had been following both strategies of streamlining by concentrating on core military business and simultaneously diversifying into related civil markets, usually in high technology. There was evidence that the companies in different nations were reacting in different ways. The French and Italian companies were striving to maintain their defence market positions in contrast to the German and British companies which were adjusting to the changes in other ways. German companies were more aggressive in diversification into civil business areas, whereas British companies were pursuing a safer strategy of plant closures, laying-off staff and sale of facilities.

The defence dependent regions are highly vulnerable to increases in unemployment. The study determined where employment cuts had already been implemented or were likely to be enforced in the short term by a survey of defence companies. The companies emphasised that industrial employment cuts were determined by commercial considerations and that industrial adjustment would take at least five years. It was impossible to predict defence company site and military base closures as the subject of defence procurement cuts and employment readjustment was highly controversial at local and at national level.

It was predicted that some regions of the EC would experience reduction in scale and closure of military bases. This would be seen in those regions in Germany with a
high proportion of foreign forces and where the withdrawal of many foreign forces is scheduled.

It was reported in the EC news sheet, "The Week in Europe" 10 December 1992, that the EC Regional Policy Minister, Bruce Milan, noted that about half the regions likely to be severely affected by the defence cuts were not eligible for EC structural funding under the EC's regional policy. Table 3.2.2 shows the regions in the UK with the highest levels of military related employment.

<table>
<thead>
<tr>
<th>UK Region</th>
<th>Employment share % in defence industry only.</th>
<th>Employment share % in military only.</th>
<th>Defence related employment share % in industry and military.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EC Average = 0.55 %</td>
<td>EC Average = 1.86 %</td>
<td>EC Average = 2.41 %</td>
</tr>
<tr>
<td>Cumbria</td>
<td>6.40</td>
<td>0.95</td>
<td>7.35</td>
</tr>
<tr>
<td>Essex</td>
<td>2.78</td>
<td>1.14</td>
<td>3.89</td>
</tr>
<tr>
<td>Lancashire</td>
<td>2.35</td>
<td>0.27</td>
<td>2.62</td>
</tr>
<tr>
<td>Cornwall and Devon</td>
<td>1.55</td>
<td>5.32</td>
<td>6.81</td>
</tr>
<tr>
<td>Avon, Gloucestershire and Wiltshire</td>
<td>1.26</td>
<td>4.25</td>
<td>5.48</td>
</tr>
<tr>
<td>Hampshire and Isle of Wight</td>
<td>1.18</td>
<td>7.83</td>
<td>8.95</td>
</tr>
<tr>
<td>North Yorkshire</td>
<td>0</td>
<td>6.25</td>
<td>6.25</td>
</tr>
<tr>
<td>East Anglia</td>
<td>0.18</td>
<td>4.34</td>
<td>4.51</td>
</tr>
<tr>
<td>Lincolnshire</td>
<td>0</td>
<td>4.10</td>
<td>4.10</td>
</tr>
<tr>
<td>Berkshire, Bucks and Oxfordshire</td>
<td>0.36</td>
<td>3.98</td>
<td>4.33</td>
</tr>
</tbody>
</table>


The study omitted the county of Hertfordshire which has a concentration of defence industries:

British Aerospace, Hatfield (previously DeHavilland Aircraft)
Prior (1993) reported that the University of York had carried out the original research and study for the EC Economists Advisory Group (1992), and in 1993 Hertfordshire County Council contacted the University of York for a study to be carried out on the impact of defence cuts on the industry of Hertfordshire.

The regions studied, for example Cumbria, in the EC Economists Advisory Group (1992) report are very large in comparison to the areas, such as Barrow-in-Furness, of defence-intensive activity which those regions contain and the report does not consider the highly localised and therefore severe employment cuts which might occur in these areas. For example the working population of the region Hampshire and the Isle of Wight is given as 664,100 and the number employed in the defence industry is 7831, (or 1.18% of the working population) and the number employed in the military is 54,674 (or 7.83% of the working population). The concentration of defence related employment within Hampshire lies in a number of industrialised areas such as Portsmouth, Fareham, Aldershot and Farnborough, (Jordan and Sons Surveys, 1984) and defence cuts are likely to impact these centres more severely than the whole of the Hampshire region.
The EC news letter, The Week in Europe 26 September 1991, has reported that some areas of the UK, Barrow-in-Furness, Merseyside, Preston, Kirklees and Strathclyde, where large military installations are being converted from military use, have benefitted from EC grants targeted at regions with fragile economies.

The EC Commission Vice President, Martin Bangeman, reported (The Week in Europe 26 March 1992) that financial aid to regions suffering from defence cuts would be difficult to justify as defence companies were often based in the more prosperous regions of the Community. Richman (1992) reports that it is commonly believed that employment cuts due to cuts in defence spending tend to occur in affluent areas but he believes there are several examples where the opposite is true. Richman (1992) considered that town centres which are culturally rich are often surrounded by a "doughnut of deprivation", which in turn is surrounded by the "affluent leafy suburbs" and Richman (1992) pointed out that whilst the head offices of major defence prime contractors are often in prestigious surroundings, the defence/engineering/electronics factories tend to be located in more deprived areas.

3.3 INDUSTRIAL BEHAVIOUR IN DECLINING MARKETS

DECLINE IN THE DEFENCE MARKET

The UK Ministry of Defence have published their estimates of the value of the annual averages of world-wide defence contracts placed or to be placed, over the period 1988 to 1997 (MOD DESO Newsletter, issue 3, February 1993). The MOD estimates are summarised in Table 3.3.
TABLE 3.3 Value of defence contracts placed annually world-wide

<table>
<thead>
<tr>
<th>PERIOD OVER WHICH THE VALUE OF THE DEFENCE CONTRACTS ARE AVERAGED.</th>
<th>AVERAGE VALUE OF DEFENCE CONTRACTS PLACED OR TO BE PLACED PER YEAR WORLD-WIDE, BILLIONS US DOLLARS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>US$43B</td>
</tr>
<tr>
<td>1993-1997</td>
<td>US$40B</td>
</tr>
</tbody>
</table>

SOURCE: Table by current author from data presented in MOD DESO Newsletter, issue 3, February 1993, p. 3.

The change in annual value of new contracts represents a decline of 20% over the period 1988 to 1997. The MOD also reports that the pattern of defence spending and defence equipment trade will continue to change:

- Countries of the Pacific Rim which includes the countries of Australasia and East Asia are expected to increase their defence procurement spends by up to 35%.

- The countries of the Middle East are expected to remain the world's largest regional market, with annual defence import levels decreasing by 25% from 1993 to 1997, to $16 to $17 billion US dollars p.a.

- The level of European defence exports is expected to fall from the 1988-1992 level by 17% by the year 1997.

- The level of North American defence exports is expected to follow a similar trend with decline of 27% by the year 1997.

- The proportion of allocation of funding between land, sea and air is not expected to change significantly over the period 1993 to 1997. There is expected to be a decline in the platform market, for example ships, tanks and
aircraft and more emphasis on electronics to improve platform capabilities and effectiveness.

Miggiano et al (1992) have reported that arms industries are having to restructure as their national and export markets decline in many parts of the world. He points out that many companies in Western Europe and in North America had scaled down their defence capacity even though they were in 1992 continuing production on orders secured before the end of the Cold War and in future with completion of these programmes the companies would have to consider reducing their production capacities further.

Defence companies are facing a declining but nevertheless substantial world arms market of $40B annually. Companies choosing to exit or to stay in the armaments business would be able to perform successfully in a declining market by employing shrewd analysis and choice of strategy.

BEHAVIOUR AND STRATEGIES FOR DECLINING BUSINESSES

Harrigan (1980) investigated behaviour and strategies for declining businesses. None of the sixty companies investigated by Harrigan (1980) were in the defence industry but it is useful to examine her findings. She uses an analogy from the game of chess by referring to the strategies in declining markets as "endgames" and the declining industrial environment as the "endgame environment". According to her analysis, market decline is characterised by a reduction in the number of competitors, a narrowing of the products on offer, the relinquishing of smaller customers and
markets and a reduction in promotional and development expenditure. Kiely (1990) in his study of the defence industry outlined the same characteristics in the defence markets of the western world i.e.

i) a reduction in the number of competitors. This has been seen in Europe and in the USA where the market is being dominated by fewer but larger companies.

ii) a narrowing of the products on offer and the relinquishing of smaller customers and markets. Companies are seeking to rationalise their range of products and technology, mainly to reduce the level of investment required to sustain the necessary threshold in a range of technologies.

iii) a reduction in promotional or development expenditure. The governments of the Western World and the former Soviet Union are severely cutting military research and development budgets.

Harrigan's hypothesis (Harrigan, 1980) was that there is no single strategy applicable to all declining markets but that the appropriate strategy depends on a number of factors in the endgame environment. She classifies possible strategies into those where the company wishes to stay in the market and those where the company wishes to exit the market as profitably as possible.
3.3.1 Options for Companies Wishing to Stay in a Declining Market

According to Harrigan (1980), a company wishing to stay in a declining market has the following options:

1. It can increase investment in order to obtain market dominance by acquiring exiting competitors or by pursuing the niche markets that are likely to remain. A company making such an investment does so because it is committed to remain in the industry and to protect the long term strategic position. Expenditure may be directed to the following: i) to ensure a degree of stability in the endgame environment, ii) to acquire exiting competitors or iii) to persuade or assist competitor companies to exit sooner. A company might, for example, initiate a "price-war" by cutting the price of goods or services to exert pressure on higher cost competitors.

The strategy of increasing the investment would be considered where it is judged that pockets of demand will endure in the endgame.

2. It can adopt a defensive strategy of holding its investment level in order to wait and see how the market develops in preference to seeking future dominance in the market. This may be appropriate where the company possesses certain competitive strengths in terms of customer loyalty in which case the level of demand is likely to remain steady or where the company has niche products, or where one of its competitors is seen as a strong threat. A
defensive strategy can also be appropriate in the case where the declining business is important to the company and the company has reasons to stay in that area of business. Harrigan (1980) considered that a company which has already made substantial investment and wished to protect the investment would be expected to try to hold its market share by making only maintenance reinvestment. Harrigan (1980) also considered that companies adopted a defensive strategy when there was a degree of uncertainty on how rapidly or in which specific market areas the decline would occur. There is, however, always the possibility with this strategy that the company which hesitates may lose an opportunity.

3. The company can chose to "shrink selectively" by trying to capture remaining niche markets and exiting the other markets. The company can attempt to become firmly established in the potentially profitable market segments and create customer loyalty in these niche areas. A supplier company has first to make a judgement concerning which customer companies will be least likely to abandon old products and convert to newer products or technologies and then to position itself to benefit from the expected demand for the endgame products. The success of this strategy may depend on sound assessment of the markets.
3.3.2 Options for Companies Wishing to Exit the Declining Market

A company wishing to exit the market, but which is unable to obtain a satisfactory return on its assets and must therefore stay in the market until it can, has two options (Harrigan, 1980):

1. Harrigan (1980) uses the phrases "milk the investment" and the "harvesting strategy" to describe the policy of diverting as much cash and resources as possible to other projects.

2. The company can divest immediately. It is critical that this action should be taken at the right time, in order that the best return on assets can be obtained.

3.3.3 Successful Performance in the Endgame

Harrigan (1980) determines success in the endgame as being when a firm remaining in the market earned above average profits, with a reasonable degree of certainty that it could continue to do so, whilst retaining the choice of exiting satisfactorily in the future. For an exiting company, success was categorised as the ability to exit without significant loss or interference with the company's other business activities. Conversely, a company was said to have performed badly in the endgame if it tried to stay in the market and lost money consistently, with the result that it was unlikely to be able to remain in the market, or an exiting company made a considerable loss and its other business interests were severely affected.
3.3.4 Factors Influencing the Choice of Strategy in a Declining Market

The factors that influence a company's choice of strategy were analyzed by Harrigan (1980) in terms of the following variables:

1. Market characteristics - The perceived reasons for and rate of decline of the market and whether there exists areas of the market where demand is maintained and how the company's expectations concern the demand.

2. Structural traits of the industry - These are broken down into:
   - product characteristics. Is the product differentiated, that is it significantly different to other products on the market?
   - buyer characteristics. Is the product bought by a only a few large customers who may exert pressure to cut prices?
   - supplier characteristics. Is the product important to "upstream" firms who might therefore be expected to aid the producer by cutting price or by improving efficiency?
   - economic exit barrier characteristics. These include the factors deterring a company from exiting because of unacceptable losses and the "volatility" of the competitive market such as whether the market becomes unstable by price warfare.

3. The effects of corporate strategies - whether the company is important to the corporate image, whether it supplies other parts of the parent company.
4. The companies internal strengths - whether it has advantages over the competition in terms of marketing skills, design and engineering skills, finance or methods of production.

3.3.5 Conditions Likely to Enable Success in a Declining Market

The sixty firms studied by Harrigan (1980) were classified according to a matrix of three variables:

1. Concentration/fragmentation - determined by the number of competitors in the market.

2. Differentiated traits/commodity traits - whether the product was markedly different to others in the market.

3. High/low exit barriers.

She found that her main hypotheses, that appropriate strategies varied with the industrial environment and characteristics and corporate requirements, were confirmed. She also established that by shrewd analysis and choice of strategies, a company could perform well in the endgame environment.

The key sensitivities and characteristics identified by Harrigan (1980) are summarised in Table 3.3.5.
### TABLE 3.3.5 Key sensitivities and characteristics in declining markets

<table>
<thead>
<tr>
<th>FAVOURABLE</th>
<th>UNFAVOURABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BUSINESS ENVIRONMENTS</strong></td>
<td></td>
</tr>
<tr>
<td>1. Demand somewhat price insensitive</td>
<td>1. Demand highly price insensitive, competitor price cutting becoming volatile.</td>
</tr>
<tr>
<td>2. Replacement units needed for predictable future period</td>
<td>2. Demand drops abruptly, causing sizeable write-offs for companies forced to exit from business.</td>
</tr>
<tr>
<td>3. Pockets of demand likely to endure indefinitely, even at a lower level.</td>
<td>3. Requirement for substantial re-investment forces companies to exit prematurely.</td>
</tr>
<tr>
<td>4. Great uncertainty about duration of demand.</td>
<td></td>
</tr>
<tr>
<td><strong>INDUSTRIAL CHARACTERISTICS—ANALYSIS OF DEMAND</strong></td>
<td></td>
</tr>
<tr>
<td>Certainty of demand</td>
<td>Uncertainty of demand</td>
</tr>
<tr>
<td>1. Which sectors/pockets of demand would decline first.</td>
<td>1. Whether demand would revitalise and when.</td>
</tr>
<tr>
<td>2. How rapidly market would decline</td>
<td>2. Generally few companies exit business in uncertainty, thus creating excess capacity. Companies are likely to operate plant at low capacity for years.</td>
</tr>
<tr>
<td>3. If demand would revitalise</td>
<td></td>
</tr>
<tr>
<td>Rate of declining demand due to technological changes are in general easier to forecast, particularly where the manufacturing company also produces the replacement product.</td>
<td>Rate of decline due to non-technological change, (for example demographic, cultural, or fashion change) is more difficult to forecast.</td>
</tr>
<tr>
<td><strong>CUSTOMER TRAITS</strong></td>
<td></td>
</tr>
<tr>
<td>Fragmented customer groups appear relatively price insensitive.</td>
<td>Concentrated customer groups appear more price sensitive.</td>
</tr>
<tr>
<td><strong>PRODUCT</strong></td>
<td></td>
</tr>
<tr>
<td>Differentiable products (differentiable by patents, brand name identification, good service record) have more staying power in a declining market, avoid competition by fulfilling a customer niche.</td>
<td>Brand loyalty erodes more rapidly, the higher the primary demand for a physical feature.</td>
</tr>
<tr>
<td><strong>SUPPLIER BEHAVIOUR</strong></td>
<td></td>
</tr>
<tr>
<td>If supplier to a company in a decline is relatively dependent on that company, then the supplier is more likely to help that company by financing/advertising/pricing discounts or other co-operation. Suppliers are not generally dependent on one company.</td>
<td></td>
</tr>
<tr>
<td><strong>ECONOMIC EXIT BARRIERS</strong></td>
<td></td>
</tr>
<tr>
<td>A company wishing to exit a declining business, may be reluctant where the company investment would be irretrievably lost, e.g. where there are new and undepreciated assets, or recent technology investment.</td>
<td></td>
</tr>
<tr>
<td><strong>STRATEGIC EXIT BARRIERS</strong></td>
<td></td>
</tr>
<tr>
<td>Corporate image barriers, to exit can exist in single-business companies, or in historical pioneers.</td>
<td></td>
</tr>
<tr>
<td>Customer linkage</td>
<td></td>
</tr>
<tr>
<td>Short term reporting goal barriers.</td>
<td></td>
</tr>
</tbody>
</table>

**SOURCE:** Summarised by the present writer from Harrigan (1980), Chapters 2, pp 13 to 43, and Chapter 11, pp 367 to 393.

The conditions most likely to enable a company to succeed in a declining market were:

1. Demand for the product was not particularly price-sensitive.
2. The replacement market was fairly secure.
3. Niche markets existed which could be easily exploited.
4. The reasons for the decline were well understood and the rate of decline predictable.
5. Differentiated markets were less likely to be invaded.

All these factors made for a stable competitive situation which was advantageous for those involved. The uncertainties created by a volatile market produced a turbulent environment in which no-one benefited. Harrigan (1980) suggests that in a declining market it would perhaps be beneficial for competitor companies to have some form of co-operative association, it being in everyone's interest to have an orderly market.

None of the companies examined by Harrigan (1980) were defence companies.

The literature has not examined the defence companies manoeuvring into favourable environments as seen in those companies who forcefully pursued export markets to the third world in the 1970s and 1980s to compensate for the diminishing domestic markets. Regional conflicts and arms races created a favourable market environment for the exporter because the demand was not highly price sensitive, there was a steady market for replacement units and niche markets were established (SIPRI Year Books, 1970, 1975, 1980, 1985, 1990). Towards the end of the 1980s there was decline in these niche markets as the conflicts ended and the third world countries began to establish their own defence industrial base.

An example of a niche market, cited by Struck (1991), is the $2.54B market for military semiconductor components and integrated circuits, which is predicted to have 11.3% annual growth rate. Struck reports that arms control agreements will lead to increasing markets in surveillance and verification systems and protection weaponry.
such as anti-missile systems, cruise missiles and smart weapons. These niche markets appear to be strongest in the Pacific Rim and in the Middle East, as reported by Forecast International (1990).

The tank industry is experiencing severe negative market trends which vividly illustrates the characteristics of the unfavourable environment identified by Harrigan (1980):

1. The Sipri Year Book 1990, Chapter 13, describes how the CFE Conventional Forces in Europe agreement requires that 2000 tanks in NATO Europe will be scrapped. This indicates an unfavourable market where the demand for new tanks drops abruptly.

2. Tanks demand highly expensive and advanced technology incorporating electronics technology at approximately 50% by value, requiring substantial investment by the tank manufacturer. This is an example of an unfavourable business environment where there is the requirement for substantial investment can force companies to exit from business.

3. There is considerable uncertainty in the level and timing of demand.

4. There are five tank producers in Europe, Krauss-Maffei, GIAT, Vickers, Oto-Melara and Santa Barbara, but only two countries Great Britain and France are expected to have a requirement of any quantity (SIPRI Year book 1991).
Chapter 3

An example of dependant and therefore co-operative supplier behaviour as identified by Harrigan (1980), is seen in the defence industry in the behaviour of suppliers of defence electronics systems and subsystems to the builders of warships where the defence system consists of high technology electronics such as missiles, anti-missiles, command and control, sensors, radars, counter-measures such as decoys, artificial intelligence and automated threat response. This dependence of the naval electronics systems companies on the ship-building concerns has led to close collaborations between ship builders and electronics companies, for example GEC, VSEL and DCN companies.

3.3.7 Divestment

Coyne and Wright (1987) studied corporate divestment, covering the adjustment process, the way in which divestments are carried out, the range of divestments from partial to complete severance and the routes by which they occur.

CATEGORIES OF DIVESTMENT

Coyne and Wright (1987) described divestment as

"the sale by an organisation of one part of itself to another party".

Table 3.3.7 shows how they classified six types of divestment by (1) the level of ownership severance, (2) the relative frequency of that type of divestment and (3) the type of resultant ownership of the divested segment of the company.
## TABLE 3.3.7 Types of corporate divestment

<table>
<thead>
<tr>
<th>TYPE</th>
<th>OWNERSHIP SEVERANCE</th>
<th>RELATIVE FREQUENCY</th>
<th>NEW FORM OF OWNERSHIP</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRANCHISING</td>
<td>Complete, limited period</td>
<td>Frequent</td>
<td>Subsidiary or independent</td>
</tr>
<tr>
<td>CONTRACTING OUT</td>
<td>Complete but trading relationship remains</td>
<td>Frequent</td>
<td>Subsidiary</td>
</tr>
<tr>
<td>SELL-OFF</td>
<td>Complete, usually permanent</td>
<td>Small sell-offs frequent, part of a series. Large sell-offs, function of crisis</td>
<td>Subsidiary</td>
</tr>
<tr>
<td>MANAGEMENT/ LEVERAGE BUY-OUT</td>
<td>Usually complete and permanent, parent may retain equity interest</td>
<td>Small- frequent Large- becoming more frequent in UK frequent in USA</td>
<td>Independent</td>
</tr>
<tr>
<td>SPIN-OFF/ DEMERGE$^R$</td>
<td>Split rather than severance, may involve dilution of ownership, usually permanent</td>
<td>Small- frequent especially in high technology where management takes equity stake</td>
<td>Quasi-independent$^1$</td>
</tr>
<tr>
<td>ASSET SWAP/ STRATEGIC TRADE</td>
<td>Complete but exchange involved so size of parent maintained</td>
<td>Unusual, small asset-swaps may arise in anti-trust divestitures. Large asset swaps voluntary.</td>
<td>Subsidiary</td>
</tr>
</tbody>
</table>

Source: Adjusted from Coyne and Wright (1987), p. 203, Table 15.1

Coyne and Wright described the forms of divestment as follows:

1. Franchising commonly involves a competition for the exclusive production or service rights in a particular area for a specified period.
2. Contracting-out involves the supply of goods or services to the parent company.
3. The third type of divestment described by Coyne and Wright is the sell-off which varies in scale from the sale of small parts or units of the parent company, to the large sell-off.
4. In the case of the management or leverage buy-out to a consortium of institutions the resultant unit becomes independent of the parent company.
5. A new company formed by "spin-off" becomes a separate legal entity but remains owned by the same shareholders as the parent company. The spun-
off company is quasi-independent in the sense that it is able to define its own management and raise its own finances.

6. Asset-swap or strategic trade involves two companies exchanging assets without the exchange of funds. This type of divestment is unusual.

**EFFECTS OF DIVESTMENT ON PERFORMANCE**

Coyne and Wright (1987) have considered the effects of divestment on company performance measured in terms of the effects on shareholder wealth. The types of divestment examined were voluntary sell-offs, voluntary spin-offs and demergers and involuntary actions or enforced divestitures resulting from competitors policies. Coyne and Wright (1987) developed the hypothesis that as the reasons for divestment varied, the effects on shareholders wealth also varied. Their examination of the literature found that in the case of enforced divestiture, the existing shareholders would lose if the company had been in a monopolistic position.

Divestments or sell-offs were regarded as involving unsatisfactory performance or misfit with the parent company activities. Where the aim of the sell-off is to create wealth, there may result an upward movement in share prices. Alexander et al. (1984) cited by Coyne and Wright (1987) found that sell-offs are usually announced after a period of negative abnormal returns whereas spin-offs are announced after a period of positive abnormal returns.

Demergers or spin-offs are associated with the problems of success. Coyne and Wright (1987) reviewed three studies on spin-offs and in all three found positive
abnormal gains to shareholders and further, that large spin-offs, involving more than 10% of the parent company, resulted in a greater positive impact on share prices. The gains in shareholder wealth were attributed to increased efficiency resulting from reduction in diversity in the parent company and the increased ability for the new separate entities to pursue their own separate interests.

Examination of the literature by the present author has not identified any studies of divestment in the defence industry, although several articles report individual cases. The Economist, 25 January 1992, reports that one of the largest USA defence companies, General Dynamics, has a plan to stay in markets where it is leader and to either expand or sell-off the less successful product areas.

3.4 THE PERFORMANCE OF USA AND EUROPEAN DEFENCE COMPANIES

Finnegan (1993) reported on the performance of the world's largest 100 defence companies and compared their performance in 1991 and 1992. He reported that of the largest 100 defence companies, 50 were USA companies, 67% of which were profitable and on average relied on defence for 46% of their sales. Of the world's largest 100 defence companies, 35 companies were European, of which 56% were profitable and on average relied on defence for 41% of sales. The figures presented by Finnegan (1993) showed that for the 50 largest defence companies the average net income in 1991 was $216.5M and in 1992 the average net income had decreased to $55.5M. He reported that the major defence companies were staying profitable by
downsizing and merging. The companies had very much reduced capital investment and research and development activities because of lack of new programmes. The companies that had adjusted quickly to the reduced defence budgets were profitable and also had increased their market shares by mergers and acquisitions.

3.5 CONCLUSIONS

1. The defence market in the western world is exhibiting the characteristics of market decline:
   i) a reduction in the number of competitors. This has been seen in Europe and in the USA where the market is being dominated by fewer but larger companies.
   ii) a narrowing of the products on offer and the relinquishing of smaller customers and markets. Companies are seeking to rationalise their range of products and technology, mainly to reduce the level of investment required to sustain the necessary threshold in a range of technologies.
   iii) a reduction in promotional or development expenditure. The governments of the Western World and the former Soviet Union are severely cutting military research and development budgets.

2. A major impact of the defence cuts has been the reduction in orders and loss of jobs in the defence industry. A number of companies are divesting of their defence related business areas and the majority of companies are restructuring.
3. Companies are trying to manoeuvre into favourable markets. This is seen in the companies who have forcefully pursued defence export markets in the Middle East and in the Pacific Rim to compensate for diminishing domestic markets.

4. Companies are attempting to become established in niche markets such as surveillance and electronics.
Chapter 4

Impact of changes in equipment procurement policy and the influence of the Independent European Programme Group
Bittleston (1990) noted that the need for change in the structure of defence industries and the way in which Western European governments carried out defence procurement had been covered extensively in the literature. Budgetary pressures and developments in arms reduction were the major force of change. Edward Heath is quoted in Bittleston (1990) as commenting on European unity that "In time there will come a common defence and procurement policy with a common foreign policy as its basis".

Moravcsik (1989) proposed a three-tiered plan for defence procurement in Europe which involved i) collaborative projects for large research and development intensive projects, for example to provide a next-generation weapon system, ii) a selection procedure of competing consortia for medium size projects and iii) free international trade for smaller procurement projects. Moravcsik (1989) reported that the most potentially effective initiatives concerning European defence procurement policy had come from the Independent European Programme Group (IEPG). The IEPG was formed in 1976 (Parry, 1991) and is composed of the European members of NATO except Iceland and is independent of NATO and the Eurogroup. The IEPG's goals include the formation of a competitive integrated European defence market and industry and agreement on common operational requirements. Moravcsik (1989) briefly summarised the main points of an IEPG Action Plan proposed in 1988 with IEPG designated as the major organisation for the co-ordination of European defence
industrial co-operation and a proposed programme for the introduction of a common
European arms market. The plan called for:

i) open bidding procedures,

ii) a standard reporting mechanism for international contracts,

iii) aid for the defence industries of Greece, Turkey and Portugal,

iv) the creation of a secretariat in Lisbon, and

v) the open competition for contracts, subject to the gains from all projects
being balanced over an appropriate period of time. The principle of Juste
Retour provides that the costs and received benefits are in proportion to the
percentage finance provided and the numbers of equipment procured by each
participating nation.

Moravcsik (1989) reported that the plan put forward by the IEPG was more strongly
supported by smaller defence companies such as the French company MATRA. The
smaller companies saw the IEPG plan as helpful in avoiding being taken over by the
large national companies. McIntosh in RUSI (1993) considers that the IEPG had
made modest progress towards the abolition of protectionist barriers to defence trade
within Europe. The IEPG has no formal or legal charter and its policies and
recommendations are not legally binding on the member countries. Moravcsik (1989)
noted that international organisations such as the IEPG can do little more than create
the environment for international co-operation.
4.1 COMPETITIVE TENDERS

The Statement on the Defence Estimates (1991) outlines the British Government's drive to a more commercial approach to defence equipment procurement. The proportion of contracts placed competitively has increased from 37% by value in 1983 to 67% in the year 1989/90, the aim being to achieve better value for money for the Government. Several publications such as Hartley (1987a), Hartley (1987b), Smith (1988), and Dunne and Smith (1983) reported the expected benefits to the country's economy of a competitive defence procurement policy. RUSI (1996) addressed the cost implications for the firms bidding: the cost of preparing a bid is typically 5% of the value of the tender, e.g. a bid cost of fifty thousand pounds on a bid valued at one million pounds. The firms have to evaluate and select very carefully which contracts to pursue. This may lead to firms becoming more selective and more specialised resulting in fewer firms bidding and then less competition for defence contracts.

The DMS consultant report, Forecast International (1990), considers that competitive tendering was introduced indiscriminately with the intention of enforcing efficiency in the defence industry and breaking the perceived undesirably close relationship between the government procurement agencies and industry. The Forecast International (1990) report concluded that competitive tendering has lead to the process of selection of the lowest cost, compliant bid. The procedure neglects other important considerations such as the ability of the contractor to ramp up to surge capacity in a time of crisis, the capacity of the company to hold sufficient stock to
cater for bottlenecks in component supplies and the capacity of the company to maintain a product support facility and an adequate research and development base.

RUSI (1996) considers the use of two other methods of non-competitive tenders which the MOD continued to use: "No Acceptable Price, No Contract" (NAPNOC), and Target Cost Incentive (TCI). McIntosh in RUSI (1993) explains that NAPNOC requires a price is formulated and agreed prior to contract placement. NAPNOC has been introduced for major contracts valued at over £10 million. The price is derived from an analysis of historical financial data by the MOD and costing details from the companies selected to tender. The TCI method results in the contractor and the MOD sharing the risk of overruns in cost and savings against the agreed negotiated price. The TCI method involves the contractor providing detailed actual costings to the MOD before contract placement and during the period of the contract.

The nature of a competitive tender requires that there exists a specification of the item or service required and when the contract has been placed the prime contractor company is responsible for project management, with reduced project management by the Government. As competitive procurement become the norm the defence industry's project management is becoming less interactive with Government. The published literature has not examined the implications of the firm-fixed price, the firm-fixed contractual requirement for the firm-fixed technical specification and the Government's (i.e. the customer's) need to change the technical requirement as the programme of work progresses in the defence industry (i.e. to change the purchase order as the goods are being designed or produced by the supplier).
Chapter 4

The payment terms for both competitive and non-competitive contracts are also becoming influenced by the Governments more commercial approach, with payments being related to attainment of specific milestones or successful completion of identified work packages. By 1990 the "costs plus percentage" contractual arrangements as opposed to firm fixed price contracts had been reduced to 4% by value of UK defence contracts to industry (Statement on the Defence Estimates, 1991).

A major consideration for industry which is not covered in the literature and which results from the increased competitive aspect is the ownership of intellectual property rights associated with an equipment which has had substantial investment for development. There are increasingly instances of firms paying for and developing high technology defence equipment, the ownership of their intellectual property rights is established and the Government will not allow the sale and export of that equipment. The published literature has not addressed this issue.

4.2 THE IEPG AND COLLABORATIVE PROGRAMMES

In the publication "Towards a Stronger Europe", the Independent European Programme Group, IEPG, has reviewed the national defence equipment requirements and identified areas for collaboration. An aim is to permit the most efficient use of funding for research and development and procurement. For example by avoiding unnecessary duplication and by encouraging standardisation and interoperability of equipment.
The recommendations of the IEPG include:

- The creation of a more open competitive defence market in Europe.
- Support of international mergers of European defence industries, to assist in the rationalisation and restructuring of the industrial base.
- Agreement on common operational requirements.
- Systematic cooperation between European countries in military research and development and production.
- Assistance to less developed European nations to develop defence technology and industrial capability.

Smith in RUSI (1993) reports that the formulation of a European Defence Union which would introduce competitive purchasing or centralised procurement, would save 20 per cent on arms purchases which represents a saving of $10 billion a year for the Western European Union countries.

Defence suppliers are entering into European joint ventures and collaborations, an example being the German, Italian and UK initiative to develop and produce the Tornado multi-role combat aircraft. The Eurogroup publication (1988) lists the major collaborative projects within NATO in 1988 and these are shown in Table 4.2.

RUSI (1996) and RUSI (1992) examined the advantages and disadvantages in collaboration on defence equipment procurement. RUSI (1996) noted that the arrangements for UK participation in collaborative defence contracts are unsatisfactory in several respects. Weston in RUSI (1993) pointed out that in a
national emergency, such as in the Falklands crisis and the Gulf conflict, British industry's ability to provide rapid engineering modifications was crucial, and that a domestic industry was able to provide a more effective response to crisis than was likely to be achieved by an overseas manufacturer. Weston in RUSI (1993) also notes that in the cases where US and UK forces were active together then US manufacturers would assign priority to the needs of the US forces before those of the UK forces.
### TABLE 4.2 Major collaborative projects within NATO in 1988

<table>
<thead>
<tr>
<th>EQUIPMENT IN PRODUCTION</th>
<th>COLLABORATIVE PROGRAMME</th>
<th>COUNTRIES PARTICIPATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAVAL EQUIPMENT IN PRODUCTION</td>
<td>TRIPARTITE MINEHUNTER, PARIS SONAR, SEA GNAT DECOY</td>
<td>BE/FR/NL</td>
</tr>
<tr>
<td>LAND EQUIPMENT IN PRODUCTION</td>
<td>FH70 HOWITZER, SCORPION RECONNAISSANCE VEHICLE, RITA COMMUNICATIONS,</td>
<td>GE/IT/UK, BE/FR</td>
</tr>
<tr>
<td></td>
<td>MULTIPLE LAUNCH ROCKET SYSTEM.</td>
<td>FR/GE/IT/UK/US</td>
</tr>
<tr>
<td>AIRCRAFT IN PRODUCTION</td>
<td>JAGUAR, TORNADO, LYNX HELICOPTER, PUMA HELICOPTER, GAZELLE HELICOPTER</td>
<td>FR/UK, FR/UK, FR/UK</td>
</tr>
<tr>
<td>MISSILES IN PRODUCTION</td>
<td>MARTEL AIR TO SURFACE, MILAN ANTI-TANK, SIDEWINDER AIR-TO-AIR.</td>
<td>FR/UK, FR/GE/UK, GE/IT/NO/UK/US</td>
</tr>
<tr>
<td>NAVAL EQUIPMENT RESEARCH AND DEVELOPMENT</td>
<td>MINESWEeper, NATO FRigate REPLACEMENT.</td>
<td>BE/NL, CA/FR/GE/IT/NL/SP/UK/US</td>
</tr>
<tr>
<td>LAND EQUIPMENT RESEARCH AND DEVELOPMENT</td>
<td>COBRA COUNTER BATTERY RADAR, MULTIPLE LAUNCH ROCKET SYSTEM PHASE III.</td>
<td>FR/GE/UK, FR/GE/UK/US</td>
</tr>
<tr>
<td>AIRCRAFT RESEARCH AND DEVELOPMENT</td>
<td>EUROPEAN FIGHTER AIRCRAFT, EH101 NAVAL ASW HELICOPTER, A129 LIGHT ATTACK HELICOPTER,</td>
<td>GE/IT/SP/UK, IT/UK, IT/NL/SP/UK, FR/GE</td>
</tr>
<tr>
<td></td>
<td>PAH2/HAC ANTI-TANK HELICOPTER</td>
<td></td>
</tr>
<tr>
<td>MISSILES RESEARCH AND DEVELOPMENT</td>
<td>TRIGAT THIRD GENERATION ANTI-TANK GUIDED WEAPON, ADVANCED SHORT RANGE</td>
<td>FR/GE/UK, GE/NO/UK, BE/FR, CA/FR/GE/IT/SP/UK/US</td>
</tr>
<tr>
<td></td>
<td>AIR-TO-AIR MISSILE, MISTRAL SHORT RANGE SURFACE-TO-AIR, MODULAR STAND-OFF WEAPON.</td>
<td></td>
</tr>
</tbody>
</table>

4.3 COLLABORATIONS AND COMMONALITY OF EQUIPMENT

The operational need for commonality and interoperability of defence equipment was pointed out in the Defence Committee's July 91 report "Preliminary Lessons of Operation Granby". This requirement applies to joint operations where more than one of the Services (army, navy, airforce) of the same nation participate and to combined operations where the forces of various nations work together.

Hartley (1987), considers that collaborative programmes are not necessarily the most cost-effective strategy for governments. He points out that (i) collaborative agreements incorporate work-sharing between the participating countries, which reduces the economies of scale that the collaboration tries to achieve, (ii) there is an additional administrative cost of collaborating and (iii) there is compromise of operational requirements between the countries. Difficulties in defence equipment collaboration have been illustrated (Electronics Times, 23 January 1992, p. 10) in the European Fighter Aircraft, EFA project and in the ASRAAM/AMRAAM missile systems collaboration. In the case of ASRAAM/AMRAAM, a Memorandum of Understanding was agreed in 1980 between the USA who would develop an Advanced Medium Range Anti-air Missile, AMRAAM and Europe who would develop the Advanced Short Range Anti-air Missile, with 45% for the UK, 45% for Germany and 10% for Norway. The Memorandum of Understanding provided the separate USA and European developments of the two systems followed by the right to purchase the other's system. After ten years the USA had completed the development of the medium range AMRAAM missile, but the European ASRAAM
development had not started because the governments of the UK, Germany and Norway were not able to reach agreement on the specifications. The USA have advised it wants to withdraw from the 1980 MOU agreement. Similar difficulties have been experienced (Electronics Times, 11 June 1992, p. 14) on the European Fighter Aircraft collaboration between Italy, Germany, UK and Spain, where the countries have different operational requirements, timing of requirements and budget priorities. The different and often changing requirements of the customers i.e. of the government of the countries in a collaboration, lead to difficulties for the collaborating suppliers, i.e. the defence industries participating in the collaboration.

Greinke (1992) reported that international collaboration in production of armaments had been successful up to the end of the Cold War, but the financial world-wide recession current in 1992 and political instability were encouraging national protectionism. He pointed out that the USA were actively pursuing collaborative programmes on armaments research, development and production with Canada, European NATO countries and other close allies, Egypt, Israel, Japan, Korea and Australia. He quantifies the benefit of collaboration in terms of a "power factor" defined as the value added to a project by carrying out the project through international collaboration.

Moravcsik (1989) described the options for the procurement of weapon systems in order of increasing national independence as (1) the import of weapons from a supplier country, (ii) the co-production of weapons under license from a foreign country, (iii) the co-development involving design and production of weapons in a
co-operative arrangement with another country and (iv) the domestic design and production of the weapon. Moravcsik (1989) pointed out that European countries procured the majority of weapons at home despite the associated high costs for example the UK and France purchasing 70 to 80% domestically together with 5 to 10% imports and 15 to 20% licensed production mainly from USA and international (mainly European) co-development projects. The preference for domestic production was supported by preferential arrangements including subsidies to domestic companies and was justified on military, political and economic grounds.

Creasey in Creasey and May (1988) found that in economic terms the most successful European collaborative programmes in defence procurement had not been genuine joint ventures but were primarily concerned with production and marketing arrangements, and excluded the precompetitive research and design phase. She points out that maximum economic benefit from collaboration in defence procurement would be realisable from collaboration in research and development. Agreements for collaborative programmes were frequently based on the existing level of market share of the companies involved rather than on the product design and development which resulted in the cooperative agreements being twenty or so years out of date because the markets were product led.
Moravcsik (1989) reported that some European collaborative projects particularly between France and West Germany were set up partly for diplomatic benefits for example the Franco-German wish to accelerate reconciliation in the 1950s and the plan outlined by Helmut Schmidt and Valerey Giscard d'Estaing to strengthen security collaboration during the 1970s.

Difficulties and impediments to international collaborations have been studied at the NATO Conference of National Armaments Directors. Parry (1991) has described how in 1989 the European members of NATO gave approval to a collaborative research and development initiative, European Cooperation for the Long term Defence EUCLID, recommended by the Independent European Program Group. The IEPG recognised that there were deficiencies and duplication in defence spending within the European NATO countries. The IEPG sought to overcome the difficulties experienced in previous research collaborations and with industrialists and governments the IEPG drew up the EUCLID Memorandum of Understanding which was signed by the nations' defence ministers. EUCLID is divided into eleven major technology areas, known as Common European Priority Areas or CEPAs. Parry (1991) has noted that the areas defined as CEPAs coincide with the priority technology research areas defined by the USA Department of Defence.

The Common European Priority Areas as listed in Table 4.4, are assigned a leading coordinating nation, which acts as a convener within the participating countries.
TABLE 4.4 The common European priority areas within EUCLID

| CEPA 1 | Modern Radar Technology | Germany |
| CEPA 2 | Silicon Microelectronics | France |
| CEPA 3 | Composite Structures | Netherlands |
| CEPA 4 | Modular Avionics | None allocated by 1991 |
| CEPA 5 | Electric Gun | United Kingdom |
| CEPA 6 | Artificial Intelligence | France |
| CEPA 7 | Signature Manipulation | Spain |
| CEPA 8 | Opto-electronic Devices | Italy |
| CEPA 9 | Satellite Surveillance Technology | Norway and France |
| CEPA 10 | Underwater Detection and Related Technology | United Kingdom |
| CEPA 11 | Human Factors Technology | Not identified |

Source: Table summary by present author from text of Barry (1991)

The general terms and conditions for EUCLID projects were outlined in the Memorandum of Understanding. Each priority area contains a number of research and technology projects, RTPs, each RTP having a lead nation with a group of international collaborators. Each nation funds its own industrial and laboratory participants. The agreement provided by the Memorandum of Understanding states that results of the research are made available for evaluation and for use by the governments within the IEPG.

Haystead (1991) has concluded that EUCLID has not succeeded due to nationalism and that the technologically leading European countries will not risk the development
of any critical defence technology to another nation. He reports that the leading
European industrialists, encouraged by their own governments, have pursued research
programmes independently from the EUCLID initiative. Unattributable sources in
UK industry report that the high cost of progress reporting and the complexity of
EUCLID project administration are deterrents against participating in EUCLID.

4.5 CONCLUSIONS

1. The change in equipment procurement policy of governments in the West has
resulted in companies becoming more selective and more specialised,
resulting in fewer firms bidding and less competition for defence contracts.

2. It is becoming almost impossible for individual countries to solely fund
research and development for new products because the costs are prohibitive.
Companies in Europe, encouraged by government initiatives, are increasingly
pursuing collaborations and joint ventures, in both technology research and
in major weapon system development and production. A disadvantage is that
nations may find it necessary to compromise their own national requirements
to fit a common development end product, for example the European Fighter
Aircraft.

3. Alliances such as NATO are seeking commonality and interoperability
between equipments of different countries' forces. This is another factor in
encouraging collaborations and joint ventures between nations.
Chapter 5

Diversification
Chapter 5

5. DIVERSIFICATION

Johnson and Scholes (1988) investigated diversification as a corporate strategy and broadly classified the different forms as backwards, forwards and horizontal diversification and the advantages and disadvantages of pursuing a diversification policy. They were not examining the defence industry, but their observations apply to the diversification activities being pursued by the defence industry:

1) Backward diversification - development of activity of inputs to a company's current business, for example raw material supply or component supply. An example of this is seen in the defence industry where GEC purchased Plessey and gained the strategically important gallium arsenide semiconductor component business. An advantage of such a diversification is the control of supply of a strategically important component.

2) Forward diversification - development of activity associated with the output of a company's present activity, for example a subsystem supplier becoming involved in a system business activity, or a servicing activity. There are very few examples of forward diversification in the defence industry, because generally defence equipment suppliers do not have the resources to progress into the business of building military platforms such as aircraft, tanks or ships. An exception is GEC who have purchased a ship building company, Yarrow Shipbuilders. The defence companies, both equipment and platform companies have always carried out servicing of their products. As defence
budgets decrease, countries will maintain their high value equipment rather than replace them, so the servicing and maintenance sector may become proportionally more important to defence companies than previously.

3) Horizontal diversification - development of activities which are competitive with or complementary to the company's current activities. Several defence companies are diversifying their product ranges into the civil markets. Defence companies will find it difficult to diversify horizontally into new defence technology areas such as stealth and anti-stealth, millimetre wave radars, monolithic microwave circuitry, lasers or infra-red technology, where they have not already invested in the necessary 10 to 20 year lead-in development phase. This is the generally accepted timescale to ramp up a technology into a military product. Companies can manoeuvre into a new military business area by taking up a technology transfer licence from another company, by acquisition of a specialist company or by a joint venture to obtain the technology.

5.1 CORPORATE DIVERSIFICATION

E.R. Biggadike, as a Ph.D. student at the Harvard Business School, studied forty corporate diversification business activities and his thesis was published as a book by the Harvard University Press (Biggadike, 1979). The study covered the entry by established corporate companies into product markets where they had not previously competed.
5.1.1. Importance of diversification for corporate growth

Biggadike (1979) cites Penrose (1959) in his assessment that corporate diversification is an important source of future growth and profitability and that diversification has provided corporate continued growth over periods up to fifty, seventy-five and eighty years. Biggadike (1979) cited the example of the USA company General Electric which started in the 1890s with a single product of incandescent lamps and had risen by diversification into more than seven hundred product markets, achieving a sales level of $17.5B per annum in 1977.

Salter and Weinhold (1979) summarised the reasons for companies considering diversification:

- Companies wish to balance out the effects of decline or cycles in sales and profits of existing mature businesses.
- There may be a wish to benefit from the business ideas and technologies generated by or evolving from the parent company's research and development.
- There may be a desire to more fully use the company's resources, for example the company may wish to diversify in order to make more use of the business skills of the top management, or the company may wish to market a new range of products through an existing distribution system.
- A company may seek to diversify in order to avoid a takeover.
- Competitive pressure or the desire to more fully serve existing customers may lead to diversification.
Companies wishing to expand may be prevented by government anti-trust laws from expanding into business areas too closely related to their core business activities and therefore the companies may seek diversification as an alternative route to growth.

Conglomerates may wish to diversify by acquisition in order to build a balanced portfolio of businesses.

5.1.2. The difficulty of corporate diversification

The study carried out by Biggadike (1979) followed forty diversification activities over the first two, four and eight years after entry. He found that on average a diversification business would take eight years to reach profitability and by extrapolating the results of the first eight years he concluded that it would take twelve years to achieve the level of profitability of a mature business. A summary of the financial performance measured by Biggadike (1979) is shown in Table 1. He pointed out that the samples studied were the survivors after the initial two, four and eight year periods and the results showed that corporate diversification is extremely difficult. He presumed that a study of the performance of all corporate diversifications attempted, including closed and surviving diversifications, would yield even worse results.

Biggadike (1979) noted that in the samples studied, there was a lack of entrants into mature markets. He cited Marris (1964) who noted that the reason given by companies for avoiding diversification into mature markets is that the conflict with
the incumbent competitors would be too intense and that managers perceive higher risks in entering mature markets.

**TABLE 1. Summary of financial performance of forty entrant businesses over the first eight years and comparison of financial performances of entrant businesses with established businesses.**

<table>
<thead>
<tr>
<th>Financial measure, per cent. Mean values</th>
<th>Years 1 and 2</th>
<th>Years 3 and 4</th>
<th>Years 5 and 6</th>
<th>Years 6 and 7</th>
<th>Established businesses, average age 18 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretax return on investment.</td>
<td>-78</td>
<td>-43</td>
<td>-5</td>
<td>5</td>
<td>21</td>
</tr>
<tr>
<td>Pretax return on sales.</td>
<td>-94</td>
<td>-35</td>
<td>-13</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Ratio cash flow / sales</td>
<td>-127</td>
<td>-50</td>
<td>-10</td>
<td>-5</td>
<td>2</td>
</tr>
<tr>
<td>Ratio gross margin / sales</td>
<td>12</td>
<td>26</td>
<td>22</td>
<td>24</td>
<td>27</td>
</tr>
</tbody>
</table>

Source: table by current author adapted from table by Biggadike (1979) p. 56.

The business activities studied by Biggadike (1979) were those where the business units entered product markets new to the parent company. He points out that there are several examples in the public domain of corporate ventures taking about eight years to become profitable and he cited

- the case of Singer who tried unsuccessfully for ten years to diversify into business machines. The business activity was still unprofitable in 1975 and the business area was closed.
- National Cash Registers reported $60M losses in 1972 primarily due to its entry into the computer business.
- in 1972 General Foods wrote-off $39M as a result of its entry into fast-food chains.
Biggadike (1979) reported that he carried out a second study covering a different sample of nearly thirty corporate diversifications and he found very similar results to those reported in his first study.

5.1.3. Performance

Biggadike assessed financial performance of diversification businesses in terms of return on investment, cash flow over investment, gross margin over sales revenues and return on sales. Market performance was measured in terms of absolute and relative market share.

He found that the performance of corporate diversification businesses varied depending on the following characteristics:

- relatedness between the new entrant business and that of the parent company,
- the market entered,
- the entry strategy and
- the reaction of competing companies already in that business.

A major conclusion was that diversification businesses should seek a high share of the served market. In particular he demonstrated that entrant businesses which had set higher prices than those of competitors had poorer financial performance than those that had matched competitors' prices. Biggadike (1979) cited the work of Buzzel, Gale, and Sultan (1975) and Fruhan (1972) which showed that those businesses
with high market share had higher return on investment than those businesses with low market share, but market share building is accompanied by poor short term financial performance.

The benefits of higher market share summarised by Buzzel, Gale and Sultan (1975) and cited by Biggadike (1979) were:

- The profit on sales rises sharply with increasing market share, but at the same time an increasing market share had small impact on the investment turnover.
- Businesses with high market share have a lower purchases to sales ratio than businesses with a low market share.
- The marketing to sales ratio declines with increasing market share.
- Businesses with higher market share were able to sell their products at higher relative prices than businesses with lower market share. The high market share businesses offered higher quality products and services than low market share businesses.

5.1.4. Relatedness between the new entrant business and that of the parent company and the impact on performance.

Biggadike (1979) classified five different types of relatedness based on functional skills, between the new entrant business and the parent company:

- technology,
- scale economy,
marketing,
vertical integration, and
conglomerate relatedness.

**Technology relatedness.** Biggadike (1979) considered that corporate research often created additional business opportunities and therefore is a most likely basis for diversification. An example quoted was the entry by Hewlett-Packard into the handheld calculator business.

**Scale economy relatedness.** Some manufacturing processes and manufacturing plants can be modified or extended to allow entry in similar markets and examples are commonly seen in paper, textile and clothing industries. Biggadike (1979) cited the examples of Kimberly-Clark's diversification into diapers with paper diapers and the entry of chemical companies into the chlorine business.

**Marketing relatedness.** Biggadike (1979) noted that a high level of expertise has been developed in some companies in marketing, for example in

- serving a particular type of customer
- differentiating their products
- low cost distribution and servicing
- exploitation of famous brand names and in the use of mass-media communications.
Examples of diversifications through market relatedness were Gillette's entry into disposable lighters and felt-tip pens, which were marketed through Gillette's mass merchandising outlets.

**Vertical integration relatedness.** Biggadike (1979) described vertical integration as resulting from adding a stage of production or service to the company's original business operation. Vertical integration has the potential advantages of lower costs through technology sharing, better distribution through supplementing the established distribution markets and higher added-value by assembling an end-product rather than a component of that product. Biggadike (1979) cited the example of Texas Instruments who were the world's largest supplier of semiconductor integrated circuits and who extended their business by vertical integration to the hand-held calculator business.

**Conglomerate relatedness.** Biggadike (1979) considered that financial skills resident in conglomerates have been the source of much diversification activity, as opposed to the technology, manufacturing and marketing skills in industry. The conglomerates will enter into a new business because the parent conglomerate has funds available for investment and because the new business shows attractive growth. The entry may also be to complete the conglomerate's portfolio of businesses. The entrant business is tied into the conglomerate in the use of central management services and in investment funding, rather than in commonality of technology, manufacturing or marketing operations.
Biggadike (1979) found commonality in forward integration entrants and technology entrants in that they were early entrants into a product market and were therefore strongly involved in market development:

- both had probably entered markets at an earlier stage than marketing entrants,
- both were in more rapid market growth areas.
- both offered incremental innovations, whereas marketing entrants offered products very similar to their competitors.
- both groups showed high research and development costs to sales ratios.

Despite the similarities listed above it was found that the forward integration entrants performed poorly in comparison to the technology entrants. Differences were found between forward integration entrants and technology entrants;

- Forward integration entrants provided the lowest quality, the highest marketing to sales ratio, negotiated the worse price/cost contracts, provoked the highest level of competitor reaction and held the lowest utilisation of capacity.
- Forward level integration entrants were likely to be seen as competitors by former customers and therefore provoked the highest level of competitor reaction.
- Forward integration entrants do not benefit from technology knowledge within the parent company and have less knowledge of the technology and manufacturing skills and have less marketing experience in their chosen
market, than the technology entrants.

Biggadike's conclusion (Biggadike, 1979) was that the marketing knowledge on design, pricing, servicing and selling the product in the chosen market is a more important factor in achieving good performance than a very detailed knowledge of an input component in the chosen product area.

Biggadike (1979) referred to the conclusion of Rumelt (1974) that corporate companies which pursued a strategy of dominant vertical integration performed less well financially than highly diversified corporate companies. Biggadike observed that the strategy of dominant vertical integration would result in the highest level of frequency of vertical integration entrants.

5.1.5. The market entered and the impact on performance.

Biggadike (1979) considered how the type of market entered had an impact on performance. His observations are summarised here:

1. Markets with a low number of established sellers are characterised by a heightened sense of rivalry and the established competitors, feeling more directly threatened may react to restrict the entrant business.

2. Biggadike (1979) examined the stages of maturity of the markets being entered, the introductory, growth, maturity and declining stages and the characteristics of diversification into those markets:
Introductory stage. Twenty eight per cent of the sample of entrants studied entered markets at the introductory stage, where the median market growth rate was estimated to be 13% per annum. The entrants faced a market development task rather than a market penetration task. The performance showed a higher marketing to sales ratio and a higher research and development cost to sales ratio, than entrants into more mature businesses. It was considered that primary demand for the product was just starting and that potential users would not be familiar with the product.

Growth stage. Thirty-seven per cent of the sample of the entrants studied entered markets at the growth stage, which has the benefit of market momentum, with an estimated total market growth rate of 15% per annum. Biggadike (1979) considered that the risks were lower than at the introductory stage, because the risks of innovation had passed, for example in the uncertainty of manufacturing technology and in the uncertainty of product acceptance. Companies also considered that the sales price in a growth business was more elastic than the sales price in a mature business and that the planned volume share should be easily attained because there was not the need to win custom from current incumbent businesses. It was considered that the technology and the market competitive structure were still changing.

Maturity. Fifteen per cent of the sample of entrants studied entered mature markets and the median total growth rate was estimated to be 3% per annum. Entrants faced the disadvantage that the demand is fairly price inelastic.
entrant is addressing a market penetration task in a mature market, in contrast to a market development task in the introductory stage. It was considered that potential users would be familiar with the products and that the technology and the competitive market structure is stable.

Declining market. None of the entrants studied by Biggadike(1979) was attempting to enter a market in decline.

5.1.6. The entry strategy and the impact on performance

Biggadike (1979) found that companies which sought a low initial market share in their diversification business performed badly in terms of achieving market objectives, in comparison with those businesses which sought high market share. In terms of market performance most (75%) low-market-share entrants did not achieve their market share objective, whereas fifty per cent of the high-market-share entrants did achieve their market share objective.

Biggadike (1979) found that entrants pursuing a strategy of shorter product lines, narrower served market segments, lower marketing budgets, higher prices and higher quality than established competitors achieved lower market shares than their competitors.
5.1.7. The reaction of competing companies already in that business and the impact on performance.

Biggadike's financial and market performance analysis (Biggadike, 1979) showed that the level of reaction by competitors is strongly linked to the entrant's performance. The entrants which experienced no competitor reaction showed better financial performance but poorer market performance than those experiencing high levels of competitor reaction. The level of reaction by established companies was determined by the magnitude of their market share loss to the new entrant.

Biggadike (1979) noted that the marketing entrants experienced the lowest level of reaction by competitors. The reasons for this were summarised:

- marketing entrants generally do not set new standards of products or services which offered incremental innovation and which established competitors might perceive as a threat.

- market entrants entered later in the product cycle than forward integration or technology entrants and the median growth rate of the market they entered was at a lower growth rate, 25%, compared to 35% and 39% growth rates of the markets entered by forward integration and technology entrants. The established competitors appeared less likely to perceive a new entrant as a threat in a lower growth rate market.
marketing entrants entered with the lowest scale of production. The established competitor considered that the maximum threat to his turnover was related to the scale of production of the new entrant and in the case of the marketing entrant this was not perceived to be significant.

5.2 DIVERSIFICATION INTO CIVIL MARKETS

Defence companies are examining the options of diversifying into civil markets with varying degrees of success. Major problems to be overcome can be lack of distribution networks, back-up servicing structure and commercial brand recognition. The existing high fixed overhead in defence companies required to support the complex administrative requirements of defence contracting are not compatible with the civil side of civil/military business. Kiely (1990) has observed that a number of major defence companies intend not to diversify from their established markets and he cited Lockheed of Canada which will continue with electronic warfare business and Yarrow Shipping which has no intention of diversifying from building warships and developing military products.

Several defence companies are applying military technology to civil products and applications:

- satellite communications for television, direct broadcast by satellite,
  - e.g. GEC Marconi (NEDC 1992)
- global positioning by satellite
encryption for secure communications
fibre optics communications
robotics
autonomous guidance  e.g. GEC Autoguide (Sunday Times 28-10-90, p. 11)
surveillance and security  e.g.Racal (NEDC 1992)
intelligent systems  e.g. Sira (NEDC 1992)
aerospace and aeronautics  e.g. GEC Avionics (Electronics Times 16-1-92,p. 11)
radas and collision avoidance
  e.g.  GEC Marconi (Evening Standard, 20-2-92 article by Sarah Fairbairn)

5.3 DIVERSIFICATION IN THE UK DEFENCE INDUSTRY

The National Economic Development Council in London carried out a survey in 1991 on the diversification activities of British defence companies. The report, National Economic Development Council, 1991, summarised the lessons learned by the companies and presented case studies of diversification by ten defence companies:

British Aerospace Enterprises
British Aerospace Military Aircraft Limited
The Dowty Group
Easams Limited
GEC Marconi Limited
Integrated Networks (Northern Telecom Limited)
Logica
Racal Avionics Limited
Redifon Limited

Sira Limited

The diversification activities of the companies reported in the National Economic Development Council publication are shown in Table 5.3.
<table>
<thead>
<tr>
<th>BRITISH DEFENCE COMPANY</th>
<th>DIVERSIFICATION ACTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>British Aerospace Enterprises Ltd.</td>
<td>Part acquisition, 49% ownership, of Kelsey Instruments. Manufacture of test and simulation equipment. New company formed, Spectrum Technologies, whose business is based on laser excimer technology, for branding cables etc. Promotion and financing of diversification activities in the British Aerospace companies.</td>
</tr>
<tr>
<td>British Aerospace Military Aircraft Ltd</td>
<td>Increased military exports. Project management of total turnkey systems such as air defence systems. Commercialisation of the company's own computer aided manufacturing system. Provision of a test range, North Sea Combat Range, for hire to military forces. Flying college. Training aids and facilities, for example cockpit procedure trainers.</td>
</tr>
<tr>
<td>Dowty Group</td>
<td>Solid lithium batteries, based on battery technology for military applications such as for sonobuoys. There are plans to approach consultants to find markets for high technology pumps developed for aircraft engine afterburners.</td>
</tr>
<tr>
<td>Easams Limited</td>
<td>Custom software development, extension of military software capability, with applications in: leisure information stock control flight monitoring transport Eurobond transactions order processing</td>
</tr>
<tr>
<td>GEC Marconi Limited</td>
<td>Direct broadcast satellite receivers for television, Design and manufacture were based on military technology and capability Marketing was through other companies well-established retail outfits. Video telephone product was based on advanced technologies, ranging from microelectronics, data compression, man/machine interfaces. Several other diversification activities, particularly in communications, are in the operating companies of GEC Marconi.</td>
</tr>
<tr>
<td>Integrated Networks (Northern Telecom Ltd)</td>
<td>In 1992 the current military business was in military radio equipment and toughened strain cables for use in underwater mine detection. Diversification activity is directed towards finding civil markets for these products, for example communication networks in civilian shipping, emergency communication networks in times of disaster or national emergency.</td>
</tr>
<tr>
<td>Company</td>
<td>Turnover/Year</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Logica Space and Defence Ltd</td>
<td>£40M in 1990/91</td>
</tr>
<tr>
<td>UK and European space business, for example civil satellite command and control systems, command and control centre.</td>
<td></td>
</tr>
<tr>
<td>Verification consultancy for security systems, for example computer security evaluation.</td>
<td></td>
</tr>
<tr>
<td>Air traffic control and management systems.</td>
<td></td>
</tr>
<tr>
<td>Information technology for national and local government, for Customs etc.</td>
<td></td>
</tr>
<tr>
<td>Racal Avionics Limited</td>
<td>£2.1B in 1990/91</td>
</tr>
<tr>
<td>Civilian cellular communications, Racal Vodaphone.</td>
<td></td>
</tr>
<tr>
<td>Satellite communications for civil aircraft.</td>
<td></td>
</tr>
<tr>
<td>Redifon Ltd</td>
<td>£21M</td>
</tr>
<tr>
<td>Military radio communications.</td>
<td></td>
</tr>
<tr>
<td>Radio communications for transport, e.g. inductive loop warning systems for railways.</td>
<td></td>
</tr>
<tr>
<td>Data broadcasting, monitoring and control using radio communications.</td>
<td></td>
</tr>
<tr>
<td>Sira Limited</td>
<td>£10M in 1990/91</td>
</tr>
<tr>
<td>Dynamic stress analysis equipment developed for military use e.g. for stress analysis of radar masts, is being applied to civil use for motor cars, engines, weld testing, airframe stress testing.</td>
<td></td>
</tr>
<tr>
<td>Laser pattern imager for measuring vibration in vehicles and power plants.</td>
<td></td>
</tr>
<tr>
<td>Testing night vision equipment, thermal imaging equipment for the armed forces.</td>
<td></td>
</tr>
<tr>
<td>Materials inspection systems for high throughput electronics manufacturing etc.</td>
<td></td>
</tr>
<tr>
<td>Source: table by present author from National Economic Development Council (1991)</td>
<td></td>
</tr>
</tbody>
</table>

The findings from this British study were very similar to those by Degrasse 1987, who studied the diversification activities of six defence companies in the USA in the 1960s and 1970s. The US report gave details of failures as well as successes in diversification but the British study detailed successes and then-current attempts at diversification. Kiely (1990) mentions some failures of British companies attempts at diversification such as manufacture of tractors and teapots, but made no analysis.
of the causes of failure.

The National Economic Development Council observed that successful diversification was based on the companies existing knowledge of the market area and or the technology or product. They cited only one example of diversification into a new market or technology, which was Easams who were part of the GEC Marconi Company and who launched a fourth generation language business area based on their existing software capability.

The main criteria for successful diversification stressed by the companies surveyed were the needs for:

- cultural change
- adequate financing for diversification
- full understanding of the market and its requirements

**CULTURAL CHANGE REQUIRED FOR DIVERSIFICATION FROM MILITARY TO CIVIL**

The companies surveyed by the National Economic Development Council strongly emphasised the need for cultural change. In the military business the priorities had always been on meeting the technical specification, followed by meeting time-scales and with the least emphasis on completing the contract to cost. Even under fixed price military contracts the engineers derived job satisfaction from offering the most excellent solutions to complex technical problems. In civilian business the emphasis
is on the best commercial deal which is available on time.

The following actions were identified as being characteristic of the cultural changes needed.

1. New top level management was required to carry out changes in the timescale required. At the shop floor level existing facilities and personnel were used. This is in contrast to the American study by Degrasse, 1978 who found that a large proportion of staff and capital were not transferred to the civil diversification activity.

2. Dedicated civil project teams were set up.

3. Civil project teams were located separately from defence project teams to aid project management and to promote the necessary change in culture.

4. Training in civil market demands.

5. Willingness to transfer existing key staff from military to civil projects and recruitment of key staff where the posts could not be filled internally.

REQUIREMENT FOR ADEQUATE INVESTMENT FOR DIVERSIFICATION TO CIVIL BUSINESS

The companies surveyed by the National Economic Development Council, 1992 reported that the diversification initiative required substantial investment. The key issues associated with the high level of investment were as follows.

1. The board of directors have to be committed to the strategy of diversification.
2. All levels of the workforce should generate ideas for diversification, but the selection of ideas to pursue must be rigorous.

3. A thorough business case including the costs of the cultural change of the company and the characteristics of the new market area must be rigorously analyzed and vetted by the company and by the financial backers.

4. The board should budget for the requirement in skills, to be acquired by training or recruitment.

5. While the diversification project is underway the board should monitor the technical progress and the cost-to-completion. In the case where the project is running over budget the board has to consider the consequences of additional finance and how the market is developing.

6. The board should regularly review the project management to determine the optimum route for the project, for example in-house or contracted out development or production. Where projects do not fit into the company's core-business the board must consider setting up a different business organisation.

7. Corporate corporations should benefit from the ability to act quickly and innovatively and simultaneously have access to the resources of a large contractor.
REQUIREMENT TO UNDERSTAND THE DEMANDS OF THE NEW NON-MILITARY MARKET

The National Economic Development Council 1992 report concludes that companies undertaking diversification into civil markets had to have thorough understanding of the new market demands. The report identified the following areas.

1. The company should have or acquire contacts and influence in the civil market that it is addressing. Acquiring contacts can be by the use of consultants, or by forming an alliance or joint venture with a company already experienced in the civil market. The National Economic Development Council 1992 noted that many of the UK companies surveyed had recruited senior marketing staff for their civil business.

2. The company must assess the rate of production that will be required and be prepared to subcontract production if necessary.

3. The company must have good competitor intelligence. It is very difficult for a company to compete in a new market against established competitors.

4. Defence companies often have a good understanding of quasi-governmental customers and markets such as transport departments or police forces and therefore can succeed in these markets. Degrasse (1987) in studying diversification in US companies in the 1960s and 1970s made the same observation in that the US defence companies were familiar with the bureaucratic complexity and often technical complexity of federal contracting and found success in addressing federal markets such as air traffic control.

5. There are growth areas within the defence markets which should be assessed.
An example given by the National Economic Development Council 1992 was the opportunity provided by the UK Ministry of Defence decision to contractorise repair and maintenance.

6. All the companies surveyed emphasised the need for staff training and the development of skills. An example of a necessary skill cited by the National Economic Development Council was the cosmetic design of products which has higher priority in civil rather than in military products.

**GENERATION OF IDEAS FOR DIVERSIFICATION INTO CIVIL BUSINESS**

The techniques used by the companies surveyed by the National Economic Development Board to generate ideas on diversification were:

- brainstorming,
- formation of forward looking teams,
- employment of external consultants and
- incentive schemes for senior management related to the success of their sector of the company.

Many defence companies have very strong research centres and the NEDC survey has reported that the companies' research centres have been the source of many ideas for diversification.
5.4 PROPOSALS FOR A UK DEFENCE DIVERSIFICATION AGENCY

Proposals for a UK Defence Diversification Agency have come from the Labour Party (Electronics Times, No 633, 2 April 1992, p. 140) and the trade unions. The proposals began by suggesting setting up "alternative-use committees" at plant, district and regional levels. Interest in diversification was revived with the ending of the Cold War and the almost simultaneous realisation that the defence industry was suffering high levels of job losses. Diversification became more attractive politically and was given a very high profile at the 1992 Labour Party Conference - although there was very little discussion as to how a DDA would operate. Three unions, the TGWU, IPMS and MSF and combined to make proposals for diversification. The Labour Party has been rather silent about the prospects for a DDA, seeming to prefer only low-key discussion.

The IPMS proposes a UK Defence Diversification Agency whose primary roles would be:

- Providing assistance with product planning.
- Assistance with the identification of new business opportunities.
- Encouraging private sector capital for diversification. Underwriting part of the risk on particular projects.
- Provision of direct financial support, conditional on employment guarantees, the formation of joint diversification committees, profit sharing with DDA or regional authorities. Support for an EC agency for defence diversification is
A role in the direction of MoD and DTI research and a "clearing house" role in providing access to technological advice and enabling technologies.

The IPMS propose the DDA should be funded by a separate Vote under the Cabinet Office, split between diversification and administrative costs. Savings from the defence budget would be used to fund the DDA for a period of up to ten years. An assessment of the cash available has been calculated on the basis of a twenty percent reduction in defence spending by the year 2000, giving a figure for the Peace Dividend of £30.55 billions by the year 2000 (£21.9 billions at 1990-91 pounds).

5.5 DEFENCE DIVERSIFICATION IN USA

The technical press (for example IEEE Spectrum November 90, Defence News etc.) presents United States defence industry as currently reorganising and restructuring with much of the impetus for these developments coming from industry itself. The USA defence budget is expected to decline from its 1992 level by around 4 percent each year from 1993 to 1997, by which time it will have declined by 37 percent from its 1985 peak.

A literature survey (The Boston Study Group 1982, R.L.Kuhn 1984 and J.E.Lynch 1987) shows that defence diversification activity in the USA is co-ordinated at the federal level, with federal agencies and legislation and also at the state level.
USA FEDERAL AGENCIES

The Department of Defence, Office of Economic Adjustment and the Department of Commerce, Economic Development Administration are the two federal agencies that provide support and assistance to local communities affected by military base closures or reductions in military expenditure and do not directly support defence contractors seeking diversification (LYNCH 1987).

THE USA DEPARTMENT OF DEFENSE, OFFICE OF ECONOMIC ADJUSTMENT

John E. Lynch, Associate Director of Economic Adjustment, Office of the Secretary of Defense, has edited a review of the USA defence diversification activity and the role of the DOD Office of Economic Adjustment from 1969 to 1987 (Lynch, 1987). The review found the defence spending was highly concentrated in specific locations: St Louis, Los Angeles, San Diego, Fort Worth, Seattle, Sunnyvale, Cincinnati, Bethpage, Marietta GA and Norfolk VA., etc. and defence cut-backs have seriously impacted specific local communities. These findings correspond to results seen in the UK where defence industry cut-backs and military base closures have had heavy impact on local communities, such as Strathclyde (shipbuilding), Bristol and Wharton (British Aerospace) etc. In examining the recovery programmes of four communities which had experienced defence cut-backs, Wichita Ks., Huntsville Al., Taunton Ma. and Hagerstown Md. and one hundred communities in re-using former military bases, the review found that each location was unique in terms what was economically and politically possible and that federal support had to be flexible and appropriate to each situation.
Within Lynch's review, Degrasse in Chapter 6 examined corporate conversion and diversification during the 1960s and 1970s in six defence companies in the USA, Kaman Aircraft, Acurex, Litton-Ingalls, Raytheon, Boeing-Vertol and Rohr Industries. He found that in general:

1. planning for diversification did not begin until after the companies had a reduction in defence orders and the planning did not involve those members of the workforce directly affected;

2. a large proportion of the existing staff and capital were not transferred to the civil diversification activity;

3. there were very few successes in establishing competitive positions in the civil markets;

4. the application of existing corporate technology to civil markets was an important technical factor in achieving success;

5. market research and planning improves the chances of successful diversification;

6. defence contractors tend to lack some skills of civilian industry such as cost-engineering, high volume production, commercial marketing, distribution and commercial customer service support such as installation and product servicing and maintenance. It was often necessary to gain these skills by methods of acquisition of companies or by recruitment of staff;

7. without a government assistance programme the process of diversification into a civilian market takes five to ten years before becoming profitable;

8. in general civilian products developed by defence companies tended to be
over-designed and inadequate testing lead to quality/reliability problems.

These observations of defence industry behaviour in the 1960s and 1970s are still recognisable in the diversification activities in the 1990s (Kiely, 1990). Degrasse's study covered diversification from military into civil business and did not include the strategy of diversification into wider military export markets. An important and significant observation by Degrasse is that government subsidy can be a source of instability in anticipating future civilian markets. This observation would appear to re-enforce a comment by the UK Secretary of Defence, Tom King, who was reported as opposing the proposal for a UK Defence Diversification Agency and considered that the defence industry would have thought of civil products to be made and would have implemented any practical ideas without government influence (Electronics Times, p. 14, 2 April 1992).

The primary purpose of the Office of Economic Adjustment is to provide assistance to the community where there are military base closures. In the UK the USA Office of Economic Adjustment have been actively involved with the UK government's Scottish Office via the Highlands & Islands Enterprise Initiative to address the problems which are likely to arise as a result of the closure of the US Navy base at Dunoon in the Cowal area (Cowal Task Force, 1991). The recommendations being made in 1992 closely follow those outlined in Lynch's review and call for community and regional initiatives rather than central government action. The recommendations are centred on the setting up of a central Task Force together with a number of subcommittees or working groups to consider specific issues such as human
resources, housing, environmental impact, economic development, education and training.

USA STATE SUPPORT FOR DIVERSIFICATION

Both Democrat and Republican state legislation provides support for defence diversification. There is no consistent pattern in the types of support being offered by the separate states. Friedman and Culbertson (in Chapter 12 of Lynch 1987) have detailed some of the state economic development programmes.

The state of Connecticut has probably been the most successful state in planning for defence cut-backs. The Connecticut Product Development Corporation was established in 1972 in response to the defence cuts at the end of the Vietnam War. In 1989 this organisation was transformed into a non-profit development agency, the Connecticut Innovations Inc. The State has provided $2 million via Connecticut Innovations Inc to assist the defence industry to diversify. An example of a diversification programme under the scheme is the civil market application by the company Dataproducts of a computer-based military communications equipment.
5.6 SWORDS INTO PLOUGHSHARES

Some notable examples of diversification, of turning "swords into ploughshares" (Bible, Isaiah, 45:18) have been vividly illustrated in the media, for example Daily Mail, 31 October 1991, p. 7, which described how Hungarian fire-fighting machines were successfully used to put out oil well fires in Kuwait at the end of the Gulf War. The retreating Iraqi troops had set fire to hundreds of oil wells in Kuwait and teams of fire-fighters from the USA, including the famous team lead by Red Adair, were tasked with dealing with the problem. An Hungarian team brought firefighting equipment built from a Russian T.34 tank chassis and two Russian MiG-21 jet engines and powered by 800 gallons of aviation fuel. The engines blasted atomised water jets at 600 m.p.h. and spectacularly extinguished the oil well fires in 4 seconds to 4 minutes.

IEEE Spectrum, November 1989, mentions that Czechoslovakia has a programme to scrap 100 tanks (T-55 type) into tractors for farming co-operatives. The Pepsi Cola company in New York accepted a negotiation for a cruiser and 17 submarines for scrap metal in partial payment for cola soft drink production at 22 factories in the USSR.

As more defence companies begin to consider diversification, a higher proportion of industry's self-funded R&D budget is being diverted from defence technology to more commercial technology and short term commercial development.
5.7 ADDRESSING THE UPGRADE PROGRAMME MARKET

As countries are following a strategy to maintain and upgrade rather than to replace their high value military platforms such as tanks, ships and aircraft, the defence industry is turning more attention to the expanding military upgrade market (Kiely, 1990). Kiely (1990) also reports that defence companies seeking to diversify into new markets for existing products are seeking international business opportunities. This has been seen in the aggressive thrust into European markets by the USA defence companies. A major arms trade has built up in exports from the Developed World to the Third World and the Emerging Nations.

Defence publishing houses have predicted an interest by industry in the upgrade market and there are new journals (such as Defence Systems Modernisation published by Granville Publications Ltd of Southampton) aimed at announcing the status of nations' upgrade programmes.

5.8 TREATY VALIDATION INDUSTRY

Some defence companies are addressing the opportunities provided by treaty verification. The scrapping and conversion of military equipment and capability has been of particular interest after the Gulf War. Adam (1988) has described several different types of sensor and inspection technology used for treaty validation.

Zorpette (1992) described how surveillance technology identified one of Iraq's most
important nuclear sites at Al Tarmiya. During the Gulf War the building at Al Tarmiya was lightly damaged by two Hellfire missiles. Within a few days aerial surveillance showed intense activity of hundreds of people repairing the site, which confirmed the strategic importance of Al Tarmiya. A few days later the site was deliberately targeted by B-52 bombers. Since the end of the Gulf War, Iraq was found to have violated the Non Proliferation Treaty by making nuclear material. Through the efforts of treaty validation teams, it was believed that most nuclear weapon facilities in Iraq have been identified and dismantled.

TABLE 5.8 shows there were seventeen major multilateral arms control agreements at 1 January 1990.
### TABLE 5.8 Major Multilateral Arms Control Agreements at January 1990

<table>
<thead>
<tr>
<th>AGREEMENTS</th>
<th>NUMBER OF PARTIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1925 Geneva Protocol</td>
<td>125</td>
</tr>
<tr>
<td>Antarctic Treaty</td>
<td>39</td>
</tr>
<tr>
<td>Partial Test Ban Treaty</td>
<td>119</td>
</tr>
<tr>
<td>Outer Space Treaty</td>
<td>93</td>
</tr>
<tr>
<td>Treaty of Tlatelolco</td>
<td>23</td>
</tr>
<tr>
<td>Additional Protocol</td>
<td>13</td>
</tr>
<tr>
<td>Additional Protocol</td>
<td>115</td>
</tr>
<tr>
<td>Non-Proliferation Treaty</td>
<td>141</td>
</tr>
<tr>
<td>NPT safeguards agreements (non-nuclear weapon states)</td>
<td>82</td>
</tr>
<tr>
<td>Sea-Bed Treaty</td>
<td>83</td>
</tr>
<tr>
<td>BW Convention</td>
<td>112</td>
</tr>
<tr>
<td>Enmod Convention</td>
<td>55</td>
</tr>
<tr>
<td>&quot;Inhumane Weapons&quot; Convention</td>
<td>32</td>
</tr>
<tr>
<td>Treaty of Raretonga</td>
<td>11</td>
</tr>
<tr>
<td>Protocol 1</td>
<td>0</td>
</tr>
<tr>
<td>Protocol 2</td>
<td>2</td>
</tr>
<tr>
<td>Protocol 3</td>
<td>2</td>
</tr>
</tbody>
</table>

Source: SIPRI Yearbook 1990, p. 638-9
5.9 CONCLUSIONS

1. Studies in corporate diversification have shown that industrial diversification is extremely difficult and that on average a diversification activity takes eight years to become profitable and twelve years to achieve the level of profitability of a mature business. Poor results of diversification businesses are often due to attempting to enter the market on too small a scale and failing to set sufficiently aggressive goals.

2. Most defence companies have attempted to diversify into new markets. In civil business some military companies are attempting to apply military technology to federal markets such as anti-drugs, customs control, firefighting, crime prevention, aviation and communications. Defence companies are familiar with the complexities of dealing with the requirements of government administration and therefore consider that they may have an advantage in winning government business.

3. Defence companies seeking to diversify into new markets for existing products are seeking international business opportunities. This has been seen in the aggressive thrust into European markets by the USA defence companies. A major arms trade has built up in exports from the Developed World to the Third World and the Emerging Nations.

4. Defence companies seeking to diversify into niche defence markets,
have found new military applications such as treaty validation and
new military opportunities such as ship and aircraft upgrade
programmes.
Chapter 6

Mergers, acquisitions and restructuring
6. **MERGERS, ACQUISITION, RESTRUCTURING**

Virtually all the western defence companies have been restructuring and cutting jobs in reaction to the changes in defence spending. Anthony et al (1990) has reported that in the arms-producing companies in USA and in Western Europe there is an increasing number of mergers and acquisitions, mainly nationally but also at an international level. Corporate divestment and acquisitions have been studied by Bing (1978) and by Salter and Weinhold (1979) and although their studies were not directed to the defence industry it is useful to study their findings.

6.1 **Corporate Divestment**

Corporate divestment has been studied by Bing (1978). Bing (1978) found that a significant number of mergers and acquisitions are achieved as a result of corporate divestment, i.e. as a result of the sale by a corporate business of a subsidiary, a division or a product line. Divestment differs from the sale of an independent business in that the seller remains in business, continues as an employer and does not become an employee.

Bing (1978) considered that the reason most commonly given by the seller for divestment, that corporate management have identified the need for a realignment of resources and a change in the nature of the business, is an oversimplification. Bing reported that divestment is often a way out of a problem and he outlined the events and conditions which may lead to the decision for corporate divestment:
1. The corporate management may wish to cast off a recurring problem or a marginal operation which is in difficulty.

2. The divestment may be a single event to give the corporate business new focus, for example by eliminating a product group or the businesses in a specific geographical location.

3. A strategy of divestment or plant closure may be pursued by new management to demonstrate dynamism and as a means to wipe out previous management errors.

4. Strategic long term planning, in that the seller may be making basic changes in business strategy and may no longer wish to remain in a particular area of business, may play a role in the decision to divest, but often the divestment is a single event associated with a failure in financial performance. The seller may need greater liquidity, or may need lower financial obligations.

5. The corporate management may decide that a business area will become too difficult or unattractive to retain, for example in connection with:
   - new environmental regulations, or trade regulations.
   - difficulty with labour relations, worker participation, productivity, or pay-role.
   - lack of confidence in the long term future of the business.

6. A government may force a sale of a business area as a result of anti-trust proceedings, which oppose trusts, monopolies and cartels which the government consider to be not in the country's best interest. Anti-trust proceedings are commonly seen in the U.S.A.
6.2 Acquisitions

Salter and Weinhold (1979) have studied the strategies of diversification through acquisition. The timescale to complete a diversification through acquisition is measured in weeks or months, whereas a diversification through internal development takes typically eight years to become profitable. Table 6.2 compares diversification through internal development with diversification by acquisition.

Table 6.2 Comparison of diversification by internal development and diversification by acquisition.

<table>
<thead>
<tr>
<th>DIVERSIFICATION BY INTERNAL DEVELOPMENT</th>
<th>DIVERSIFICATION BY ACQUISITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>The diversification activity takes typically eight years to become profitable.</td>
<td>An acquisition can be completed in months.</td>
</tr>
<tr>
<td>Development of a new business area takes years of sustained detailed planning.</td>
<td>The decision to proceed with an acquisition is made relatively quickly, typically within weeks or months. Acquisition candidates become available without advanced notice. Favourable environmental conditions for acquisition can emerge and disappear in extremely short timescales.</td>
</tr>
<tr>
<td>Companies wishing to diversify must overcome entry barriers by committing resources to establish key success variables: specialist managerial and technical skills, exclusive distribution, product image and brand recognition, copyright, trademarks and patents.</td>
<td>Cost to entry and time to entry may be lower because a number of the key variables may already be highly developed or in place.</td>
</tr>
</tbody>
</table>

Source: Table by current author from analysis by Salter and Weinhold (1979)

Salter and Weinhold (1979) studied economic research publications covering acquisitions in manufacturing industries in the USA during the period 1895 to 1978. They found that acquisition activities were cyclical and the peaks of the cycles coincided with peaks in economic activity or stock prices:

- 1894 to 1905, Merging for Monopoly.

There was a peak in the number of mergers and acquisitions during
the period of economic expansion from 1895 to 1905 following ten years of economic stagnation. The mergers were mainly horizontal integrations initiated to achieve market dominance. Several US industrial giants originated in this period, for example US Steel, General Electric, Eastman Kodak, Du Pont. Salter and Weinhold (1979) cited Stigler (1950) who described the wave of activity as merging for monopoly.

1920s, Merging for Oligopoly.

Stigler (1950) documented a second wave of mergers and acquisitions during the 1920s which he called merging for oligopoly. Most of the mergers and acquisitions involved market share additions or vertical integration and the result was the formation of strong competitors to industries previously dominated by a single large company, particularly in the electricity, gas and water holding industries. Examples of companies originated in this period are Allied Chemical, Continental Can and Kraft.

Post World War II, Merging for Growth.

The third cycle of merger and acquisition activity described by Salter and Weinhold (1979) started after World War II and involved mainly small to medium size companies as the acquirers of small to medium companies in unrelated business areas and thereby generating diversified companies. These mergers and acquisitions brought
In examination of acquisitions since 1970, Salter and Weinhold (1979) have noted that in acquisitions of US companies, American acquirers tended to purchase unrelated businesses, in contrast to foreign acquirers which pursued acquisitions related to the existing businesses. They also found that widely diversified companies performed poorly relative to industry averages, particularly in productivity of capital and in lower returns on assets and equity and that related-business companies consistently outperformed unrelated business companies.

6.3 RESTRUCTURING IN THE DEFENCE INDUSTRY

Anthony et al (1990) reported that there had been an increasing number of acquisitions and mergers in the defence industry, mainly nationally but also internationally.

Walker and Gummet (1989) have studied Britain and the European armaments market and reported a trend towards further industrial concentration within nations resulting in fewer and larger defence contractors and consequently less competition for defence contracts and loss of flexibility in the scope of technical solution to a contractual requirement. Where a nation may have only one supplier for a major programme, the nation can increase competition for that programme by encouraging international bids. Europe has been encouraged by the IEPG to promote an open defence market.
Defence contracts bulletins announcing details of defence procurement plans are published and exchanged by the UK, Turkey, Norway, Netherlands, Italy, Germany, France, Denmark and Belgium.

6.3.1 National Mergers and Acquisitions

Many major contractors have left the defence business or have been merged: Hazeltine, Sanders, Gould, Argo and Tracor; Daimler-Benz acquired Messerschmitt-Bolkow-Blohm; the UK General Electric Company and Siemens have acquired Plessey; GEC has also acquired Ferranti. The Sipri Yearbook 1990 points out how there has been a trend to national concentrations of industrial strengths in defence capabilities as demonstrated in Table 6.3.

<table>
<thead>
<tr>
<th>Number of companies able to build helicopters</th>
<th>Year 1968</th>
<th>Year 1988</th>
</tr>
</thead>
<tbody>
<tr>
<td>In USA</td>
<td>18</td>
<td>10</td>
</tr>
<tr>
<td>In France</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>In UK</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

Source: table by present author from data presented by SIPRI, 1990.

Miggiano et al (1992) have pointed out that the world's two leading weapons manufacturers are pursuing opposite strategies in that McDonnel Douglas, with half its sales in military systems, has decided to strengthen its civil business, whereas General Dynamics, with 80% of its sales in military systems, is selling off some of its civil businesses and is attempting to strengthen its military operations.
FIGURES 6.3.1 a, b and c

Figures showing the mergers and acquisitions in the evolution of the aviation industries in France, Germany and the United Kingdom from 1940 to 1990.

Figures by present author, adapted from figures presented by Ambos (1992).
Evolution of the French Aviation Industry

Aerospatiale

DASSAULT AVIATION
BREGUET AVIATION

NECRA
Breguet Aviation
AMD
Potez
Air Froge

SE Aviation
Sud Aviation
Quest Aviation

SNIA
Nord Aviation

SNCAN
SPECIALS
Ambos (1992) cited the increasing importance of technology and the increasing complexity and size of defence systems and defence projects as leading to strategic industrial alliances. In his study of the defence and aerospace industry he showed the same trend over the period 1940 to 1990 to industrial concentration by merger and acquisition, in Germany, France and the United Kingdom. Figures 6.3.1 a, b and c show the striking similarity in the reduction of numbers of companies in the evolution of the aviation industry in France, Germany and the United Kingdom.

Miggiano et al (1992) in their study on arms production found that the arms sales of the 100 largest arms producers in the Organisation for Economic Co-operation and Development, OECD, increased by 6% from 1989 to 1990, from $172B per annum in 1989 to $182B in 1990 despite a decline in world military expenditure. It was reported that the large companies have been able to increase their share of the declining arms market and it was identified that in a number of these cases the increases were as a result of mergers or acquisitions of other arms producing companies. Miggiano et al (1992) reported that of the leading 100 defence companies, more companies had increased their arms sales from 1989 to 1990, than had decreased sales. Examples of companies which had increased the level of annual sales by more than $400M p.a. were GEC, British Aerospace, GIAT, Thomson, Bremer Vulcan, Loral and Aerospatiale which had all acquired military divisions of companies or complete companies. Honeywell and Ford had decreased the level of military sales by $1040M p.a. and $400M p.a. from 1989 to 1990, partly due to divestment of some military business operations. Sir Raymond Lygo, chief executive of British Aerospace, had predicted this phenomenon in 1989 (Reed, 1989) when he
said

"... the big dogs will eat the little dogs, spit the bones out and we will have a centralised defence industry".

6.3.2 International Alliances, Mergers and Acquisitions

Anthony et al (1990) reported that during the previous two years, 1988 and 1989, there had been international mergers (Table 6.4) and acquisitions (Table 6.5) involving large arms producing companies.

Table 6.4 International mergers in the arms production industry

<table>
<thead>
<tr>
<th>COMPANY</th>
<th>NAME OF MERGED COMPANY</th>
<th>YEAR OF MERGER</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAP Group UK</td>
<td>Sema Group</td>
<td>1988</td>
</tr>
<tr>
<td>Sema-Meta France</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hybrid Memory Products UK</td>
<td>Dense Pack</td>
<td>1989</td>
</tr>
<tr>
<td>Dense Pack Microsystems US</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sepa Italy</td>
<td>Italiana Sistemi Inerziale</td>
<td>1989</td>
</tr>
<tr>
<td>Sagem France</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 6.5 International acquisitions in the arms production industry

<table>
<thead>
<tr>
<th>PURCHASING COMPANY</th>
<th>PURCHASED COMPANY</th>
<th>YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bombadier Inc</td>
<td>Short Brothers PLC</td>
<td>1989</td>
</tr>
<tr>
<td>CAE-Link Corp.</td>
<td>Singer Link divisions</td>
<td>USA 1988</td>
</tr>
<tr>
<td>Matra</td>
<td>Fokker Space, Communications and Electronics, and Control Systems divisions</td>
<td>1989</td>
</tr>
<tr>
<td>SNECMA</td>
<td>FN Moteurs Belgium</td>
<td>1989</td>
</tr>
<tr>
<td>Thomson CSF</td>
<td>ISAG Germany (FRG)</td>
<td>1989</td>
</tr>
<tr>
<td>Thomson CSF</td>
<td>Ocean Defence Corp USA</td>
<td>1988</td>
</tr>
<tr>
<td>Alcatel</td>
<td>ACEC Space, Defence and Telecommunications division, Forges de Zebrugge Belgium</td>
<td>1989</td>
</tr>
<tr>
<td>Thomson-Brandt</td>
<td>Siemens Germany (FRG) Plessey Radar and Defence UK</td>
<td>1989</td>
</tr>
<tr>
<td>Siemens</td>
<td>Diehl Germany (FRG) Bodenseewerk Gmnettechnik USA</td>
<td>1989</td>
</tr>
<tr>
<td>Elsag</td>
<td>Bailey Controls USA</td>
<td>1989</td>
</tr>
<tr>
<td>Nobel Industries</td>
<td>Phillips Elektronikindustier Holland</td>
<td>1989</td>
</tr>
<tr>
<td>Astra</td>
<td>BMARC Switz.</td>
<td>1989</td>
</tr>
<tr>
<td>Astra</td>
<td>Poudierie Reunie Belge Belgium</td>
<td>1988</td>
</tr>
<tr>
<td>Plessey</td>
<td>Leigh Industries Canada</td>
<td>1988</td>
</tr>
<tr>
<td>Dowty</td>
<td>Palmer Chenard Industries USA</td>
<td>1989</td>
</tr>
<tr>
<td>General Motors</td>
<td>Rediffusion Simulation UK</td>
<td>1988</td>
</tr>
<tr>
<td>RDO Enterprises Inc</td>
<td>ASA UK</td>
<td>1989</td>
</tr>
</tbody>
</table>

Source: Adapted from table by Anthony et al (1990), SIPRI Yearbook 1990, page 336

Anthony et al (1990) found that whilst there was a long history of international acquisitions and mergers in civil business, the phenomenon of international mergers and acquisitions in the arms producing companies was new. It was reported that weapon system manufacturers had previously operated within their own national boundaries, or in the case of the most expensive weapons systems developments such as in the aerospace business, manufacturers had previously operated in international teams without significant cross-border investments.

Ambos (1992) considered that three factors were influencing the defence industrial base resulting trend towards international cooperations and strategic alliances:
trade and investment barriers were vanishing, for example 1) the single market of Europe 1992 and 2) the opening of markets with Eastern Europe.

competition across national borders and industries has increased.

the level of investment and the financial risk required to carry out defence business were beyond the resources prepared to be committed by individual companies, and sometimes by individual nations.

Dickerson (1992) has reported that the US Congressional Conference Committee took decisive action to control foreign ownership of US defence companies. Foreign governments and foreign owned companies are not permitted to purchase 36 of the largest US defence companies, or any companies working on black (US secret) programmes. The Committee also set up the requirement that the Pentagon must i) monitor all contractors of foreign ownership, ii) monitor any accumulation of any critical technology by foreign owners and iii) monitor exports to assess the risk of diverting military technology. The attempted take-over of the US company LTV by the French company Thomson-CSF was strongly resisted (Schneider, 1993) not only to provide national protection of critical technology but also because there was concern over the market consequences of Thomson's state ownership.
6.3.3 Alliances in the Defence Industry

Moravcsik (1989) reported that an extremely important aspect of European and US defence planning was the level of internationalisation of the defence industries. Moravcsik (1989) found that potential cost saving from using competitive procurement amounted to less than 10% of the equipment costs and that further saving was limited by inadequate production runs. Moravcsik (1989) reported that governments had in the few years preceding 1989 begun to encourage forms of international co-operation in the form of procurement of foreign systems, in international mergers and acquisitions, transborder investments and international collaboration in launching common products. Moravcsik (1989) reported a trend in transatlantic rather than European mergers and acquisitions. Moravcsik (1989) noted that mergers and acquisitions tended to involve the purchase of electronics companies which resulted in increased vertical integration rather than horizontal integration which would result in increased economies of scale and improved efficiency. Moravcsik (1989) considered that the trend to vertical integration in the defence industry suppressed competition which could result in reduction of efficiency. The trend to increased internationalisation reported by Walker and Gummet (1989) continued through 1990 and 1991 according to Finnegan (1993) and Anthony (1993) but international mergers and take-overs are becoming less frequent than international alliances and joint-ventures according to Verret (1991). Verret (1991) pointed out that only two large scale international defence industrial mergers had materialised, Siemens with Plessey and Thomson-CSF with Signaal. Alliances are often set up to address a specific project or the development of a specific family of weapons as
industry finds relatively fewer problems in dissolving an alliance in the event of the 
project cancellation or postponement by governments (Verret, 1991). McCard (1992) 
reported on USA/European alliances

6.3.4 USA/European Acquisitions, Collaborations and Alliances

McCard (1992) has briefly traced the history of the "two-way street" of defence trade 
between the USA and Europe. He noted that the strong Anglo-American partnership 
was founded in World War II with the establishment of a Combined Chief of Staff. 
He noted that the memoirs of the military leaders revealed problems relating to lack 
of interoperability of equipment. In order to overcome problems interoperability was 
driven by the countries' leaders and as a result Anglo-American industrial 
partnerships were developed. Industrial collaborations strengthened the NATO 
Alliance during the Cold War. McCard (1992) reported that during the period 1976 
to 1980 the United States initiated four major cooperative efforts relating to defence 
trade:

- Memoranda of Understanding were agreed between the USA and individual 
  European countries which allowed defence markets to open between the USA 
  and each country (McCard, 1992).
- The revision of the USA Arms Export Control Act allowed co-operative 
  programmes with allies without surcharge (McCard, 1992).
- USA designed military equipment was allowed to be manufactured in Europe 
  under licence, for example the Sidewinder and Maverick missiles (McCard, 
There was USA and European agreement to develop the "Families of Weapon Systems" whereby the USA and Europe would separately develop weapon systems and cross licence production to the other partner (McCard, 1992).

McCard (1992) reported that the results in terms of trade to the USA which resulted from these initiatives was disappointing to European industry. The level of defence trade from the USA to Europe is about twenty times higher in value than the defence trade from Europe to the USA.

Europe continued to seek access to the USA defence market by industrial teaming arrangements, for example the Hawk trainer aircraft programme and by acquisition and investment by European companies, particularly by British and to a lesser extent German and French companies, in USA defence industry. McCard (1992) has pointed out that the success of European companies in the USA defence market has been achieved mainly by the vehicles of teaming, acquisitions and investment and not so much by direct trade.

6.4 INTERNATIONAL COLLABORATIONS, OFFSETS AND TECHNOLOGY TRANSFERS

Glasse (1990) has noted that whilst the world defence market contracts, the defence budgets of several Third World countries may be increasing and that the markets of
the former Warsaw Pact countries which were previously closed to the West may become available to them. Glasse (1990) reported that many West European contractors will find it necessary to enter into collaborations. Kiely (1990) reported that there had emerged a trend where foreign buyers were seeking contractual terms and conditions involving through-life aspects of maintenance, repair, training, offset arrangements and manufacture abroad. Western companies have found it necessary to establish in-country capacity to serve these markets. Glasse (1990) also noted that with the benefits of technology transfers, the newly industrialised countries such as South Korea, China, Brazil, Israel and South Africa are emerging as major international defence suppliers, resulting in an increased level of competition in an already highly competitive market.

6.5 RESTRUCTURING IN THE US AND IN THE EUROPEAN DEFENCE INDUSTRIES.

Finnegan (1993) has reviewed the status of restructuring in the defence industries of the USA and Europe in his study of the world's top 100 defence companies ranked in order of defence sales.

USA

Finnegan (1993) reported that USA companies dominated the list of the world's defence companies in size and in number. He found that the US defence procurement budget had been cut but the US research and development budget had been held level over recent years. US companies had been more aggressive than the
European companies in closing facilities and in cutting workforces. Finnegan reported that the next phase of restructuring of the defence industry would be consolidations and that the industry would shrink as a result of further acquisitions.

EUROPE

In his observation of the European defence industries, Finnegan (1993) reported that European companies were ahead of US companies in terms of consolidation, but while the companies of the United Kingdom had cut costs, there had not been marked cost saving in Italy and in France. Finnegan reported that the defence procurement and the defence research and development budgets were continuing to be cut.

UNITED KINGDOM. Anthony (1993) has reported on the privatisation of the major defence companies initiated by the former UK Prime Minister's (Margaret Thatcher's) denationalization programme. The UK defence industry has been characterised by acquisitions and downsizing.

ITALY. Politi (1993) reported a proposal by the Italian government for the leading Italian aerospace and defence companies to form a major defence conglomerate which would constitute more than 96% of the Italian defence industry.

FRANCE. Schneider (1993) has described how the French government is financing global direct investment in the world's defence industry, particularly in the missile and defence electronics industries. Table 6.5 shows that during 1988 and 1989 six
major international defence acquisitions were carried out by France, four by the UK, two by Canada, Germany and the USA, and one each by Italy and Sweden. France has chosen to retain state ownership of its major defence companies and has blocked foreign investment in strategically important French defence companies (Schneider 1993).

GERMANY. Anthony (1993) reported that Germany's arms industry is small in comparison to other German industries. Since the 1970s Germany has undertaken several armaments programmes under collaborative projects with other NATO countries. During the 1980s there was a concentration of the German defence companies.

Finnegan (1993) reported that in general consolidation had already taken place in the European aerospace industry and therefore further consolidation would probably be achieved by cross-border alliances.

Finnegan (1993) found that the overall profitability of the 50 largest defence companies had reduced from 1991 to 1992, despite having a larger market share and concluded that the leading defence companies of the developed world had been able to stay profitable by downsizing and merging. The companies have substantially reduced capital investment and research and development because of the lack of new defence procurement programmes. The companies that had adjusted quickly were profitable and had increased their market share by merger and acquisition. The companies remaining in the defence industry can now seek new growth by winning
business in the emerging and developing world.

6.6 CONCLUSIONS

1. There has been a trend in USA and European defence companies towards mergers and acquisitions, resulting in USA and European defence activity being dominated by fewer and larger companies. These major defence companies, which are the established traditional suppliers, are staying profitable by downsizing and merging. The companies have very much reduced their capital investment and research and development expenditure because of the lack of new programmes.

2. The companies that have adjusted quickly are profitable and have increased their market shares by mergers and acquisitions. The companies that remain have access to a substantial world market and therefore can be successful profitable companies, but they can only now grow by winning business in the growth markets of the emerging and developing world.
Chapter 7

Hypothesis
7.1  CONCLUSIONS FROM THE LITERATURE REVIEW

7.1.1 The Defence Market

The review of the literature carried out in Chapter 1 showed that for several decades following the end of World War II the Western and Soviet defence industries had the benefit of largely stable and steadily growing markets. This was based on the "military balance" and the policy of deterrence between NATO and the Warsaw Pact. There was increasing scale of investment in defence procurement and increasing scale of sophistication in military technology. In the United Kingdom, the relationship between government and industry has traditionally been that between supplier and principal and sometimes only customer, the Ministry of Defence. The relationship began to change in the mid-1980s with the introduction of competitive tendering and the government actively seeking a wider choice of supplier, including foreign suppliers. Similarly, the defence industries sought to widen their customer base to include foreign governments.

In 1989 the end of the cold war was brought about by diplomatic and political changes in the East and West and the defence industries were faced with a long term decline in domestic and world markets. The break up of the Warsaw Pact and the removal of Soviet control in Eastern Europe has led to an unprecedented level of ethnic violence and civil strife. The world has become extremely unstable with 37 major armed conflicts in 1990 and an increasing number of countries developing or purchasing highly advanced weapons systems capabilities including chemical, nuclear
and biological weaponry. The proliferation of arms sales to warring factions by countries hungry for foreign currency, particularly US dollars, is a serious issue and is leading to increased levels of violence. The literature reviewed in Chapter 2 showed that Third World countries are building up substantial weapons arsenals. Whilst defence expenditure in the west has been decreasing since 1987 to the present (1996), defence expenditure in the Far East and in the Middle East has risen.

7.1.2 Defence Trade

Examination of the world military expenditure data measured in 1988 US dollars (presented by Wulf, 1993) shows that over the decade 1981 to 1991 the world military expenditure rose from $1.6M per minute ($825B per annum) in 1981 to a peak of $2M per minute ($1000B per annum) in 1987 and then fell back to the 1981 level again in 1991.

The literature reviewed in Chapter 2 showed that in the decade 1981 to 1991 nearly 90% of defence exports into the Third World and the emerging nations have been the products of just six nations, the USA, the former USSR, France, UK, China and Federal Republic of Germany. A large number of Third World countries will only enter into military equipment purchases if the supplier provides offset and technology transfer arrangements. Countries such as those in the Pacific Rim with emerging economies and a growing technology base, are no longer willing to accept western equipment without some form of counter trade. They want to "catch up" with Europe and North America and believe they have the bargaining edge to do so.
countries are being asked to enter into technology transfer agreements, offset and counter trade and technical assistance in setting up in-country manufacture. The Third World countries are emerging as manufacturers and exporters of military equipment and military technology in the Third World is becoming increasingly sophisticated.

7.1.3 Industrial Response to Defence Market Decline

The defence market in the western world is exhibiting characteristics of market decline:

i) a reduction in the number of competitors. This has been seen in Europe and in the USA where the market is being dominated by fewer but larger companies.

ii) a narrowing of the products on offer and the relinquishing of smaller customers and markets. Companies are seeking to rationalise their range of products and technology, mainly to reduce the level of investment required to sustain the necessary threshold in a range of technologies.

iii) a reduction in promotional or development expenditure. The governments of the Western World and the former Soviet Union are cutting military research and development budgets.

iv) Examination of the data (presented by Finnegan, 1993) on the worlds leading defence suppliers in the year 1992 shows that 55 companies had increased their turnover since the previous year 1991, 41 had decreased turnover, one
company had the same turnover and three new companies had been created.

Of the top 100 companies fifty were American, thirty-five European, six Japanese and the other nine Canadian, Israeli and South African.

A major impact of the defence cuts has been the reduction in orders and loss of jobs in the defence industry. The majority of companies are restructuring and a number of companies are divesting of their defence related business areas. Those companies retaining or strengthening their defence businesses are trying to manoeuvre into favourable markets. This is seen in the companies who have forcefully pursued defence export markets in the Middle East and in the Pacific Rim to compensate for diminishing domestic markets. Several companies are attempting to become established in niche markets such as surveillance and electronics.

7.1.4 National and International Collaboration in Weapons Systems

It is becoming almost impossible for individual countries to solely fund research and development for new products because the costs are prohibitive. Companies in Europe, encouraged by government initiatives, are increasingly pursuing collaborations and joint ventures, in both technology research and in major weapon system development and production. A disadvantage is that nations may find it necessary to compromise their own national requirements to fit a common development end product, for example the European Fighter Aircraft. Another factor in encouraging collaborations and joint ventures between nations is that alliances such as NATO are seeking commonality and interoperability between equipments of
different countries' forces.

7.1.5 Mergers and Acquisitions

There has been a trend in USA and European defence companies towards mergers and acquisitions, resulting in USA and European defence activity being dominated by fewer and larger companies. According to literature reviewed in Chapter 2 the level of high technology being demanded in several types of major weapon systems favours large suppliers with substantial technology resources, or specialist companies with capabilities in niche technologies. Companies wishing to gain access to specialist technologies in other organisations can gain those technologies in a realistic timescale by mergers, acquisition or by joint venture.

The literature reviewed in Chapter 6 reported that the major defence companies, which are the established traditional suppliers, are staying profitable by downsizing and merging. The companies have very much reduced their capital investment and research and development expenditure because of the lack of new programmes.

The companies that have adjusted quickly are profitable and have increased their market shares by mergers and acquisitions. The companies that remain have access to a substantial world market and therefore can be successful profitable companies, but they can only now grow by increasing market share or by winning business in the growth markets such as those of the emerging and developing world.
7.1.6 Diversification in the Defence Industry

Studies in corporate diversification reviewed in Chapter 5 showed that industrial diversification is extremely difficult and that on average a diversification activity takes eight years to become profitable and twelve years to achieve the level of profitability of a mature business. Poor results of diversification businesses are often due to attempting to enter the market on too small a scale and failing to set sufficiently aggressive goals.

According to the literature reviewed in Chapter 5 most defence companies have attempted to diversify into new markets. Failed attempts at diversification and the associated costs were not widely reported in the literature. Defence companies seeking to diversify into niche defence markets, have found new military applications such as treaty validation and new military opportunities such as ship and aircraft upgrade programmes. Defence companies wishing to diversify into new markets for existing products sought international business opportunities. This was seen in the aggressive thrust into European markets by the USA defence companies. A major arms trade has built up in exports from the Developed World to the Third World and the Emerging Nations.
7.2 DISCUSSION

Defence industries are undergoing profound change as a result of the decline in defence procurement budgets and changes in the patterns of defence trade, including an intensification of international competition. There has been a major downsizing and restructuring of the defence industry and a set of dominant defence companies are emerging. At the same time several defence companies have attempted to diversify into civilian business areas such as transport, telecommunications and environmental systems.

The defence companies seeking to consolidate their position as defence equipment suppliers have had the option of increasing investment in order to obtain market dominance by acquiring existing competitors and by pursuing niche markets that are likely to remain. The pattern of mergers and acquisitions has been seen in America and in Europe where the defence industry has become dominated by large defence contractors.

Since the downturn in defence spending which began in 1988 to the present, 1996, there has been limited opportunity for defence market growth in the developed world and the main instrument for growth in the west has been by acquisition to increase market share. The main area for defence market growth since 1988 has been in the developing world where there has been growth in indigenous arms production and in the Middle East and Far East where military spending has continued to rise.
An imbalance in the military equipment trade has existed for many years and continues to apply. The third world and the emerging nations have been equipped to a large extent with the products of relatively few nations. In recent years attempts have been made to redress this imbalance by the introduction of offset agreements, technology transfer programmes and counter trade agreements, but an imbalance probably still exists. Western suppliers have been required to provide licensed production arrangements in the emerging nations and there has been a gradual increase in the level of domestic arms production in these countries, including a level of indigenous production.

7.3 HYPOTHESIS

The relationship to be explored is that the setting up of licensed production in-country by exporting nations results in the recipient nation undertaking indigenous production. Licensed production is the manufacture of the system in the recipient country to the design and specification provided by the supplier country. Indigenous production is the complete design and domestic manufacture of the system in the country being studied. The literature review has shown that the emerging nations have used both types of domestic arms production and the study examines the relationship between the two.
7.4 THE RESEARCH STRATEGY

The strategy employed was to test the hypothesis with:

1. a macro analysis of twelve countries over 25 years (Chapter 8)
2. case studies of ASEAN, Israel, Australia and Japan (Chapter 9)
3. a survey (Chapter 10), and finally
4. validation interviews and consultation with experts in the defence industry and arms trade.

7.4.1 The Macro Analysis

The measurement of the level of indigenous production over a period of time when licensed production arrangements have been provided to the importing country will show whether a relationship exists. If the result shows a correlation between the values and if there exists a meaningful time lag between licensed production and any resultant indigenous production then the existence of the relationships will be supported. If it is the case that there is no relationship between the value of licensed and indigenous production or if there is no meaningful time lag then the relationship will not be supported. A reasonable time lag might be five to ten years. The literature review showed that the time scale to set up a diversified production activity in industry was about 5 years. The Japanese have established production in about ten major weapons types in the fifty years from 1945 to 1995, i.e. about 5 years per indigenous production type.
The relationships to be explored can be expressed mathematically as:

\[ \text{Indigenous Production} = f(\text{Licensed production}) \]

The units to be measured for the \textit{Licensed production} and \textit{Indigenous Production} variable are a measure, valued in constant year US\$, of the value of licensed and indigenous arms production in the countries being examined. Data banks are readily accessible on the world trade in arms. Publications listing arms and military trade figures for virtually all countries include those by SIPRI, USA Congressional Research Service, US Arms Control and Disarmament Agency.

\textbf{THE UNITS AND THE SETTING TO BE STUDIED IN THE MACRO ANALYSIS}

The units to be studied are the arms production figures for the emerging nations over a timescale of twenty-five years through the use of records and historical data. There are limitations on the accuracy of the data because the sensitivity of the information is such that it is unrealistic to expect governments to disclose information fully. Multinational defence databases are compiled by estimate and judgement of defence trade reports in several publications, for example the source of the SIPRI database is information from approximately 200 publications covering newspapers, periodicals, journals, books, monographs, annual reference documents, national documents, documents published by international organisations and documents published by intergovernmental organisations. A key assumption made in this project is that the validity of assessing trends in the defence trade is dependant on consistency in the
measurement and counterchecking of defence trade rather than in the absolute accuracy of the data.

The Stockholm International Peace Research Institute, (SIPRI), maintains databases of the values of deliveries of defence equipment in each year. The figures do not indicate accurately the prices paid. The price being paid on each contract would reflect the level of inclusion of spare parts, training, support, offset arrangements and international military aid and grants. In the case of production under licence in the importing country, the SIPRI data bases include an estimate of the imported share of equipment. Access to the SIPRI databases for the researcher has been provided by SIPRI.

7.4.2 Case Studies

The case studies examine the nature of defence production in countries in a variety of situations. This project proposes to investigate records of national defence budgets, export military equipment sales, technology transfers and offset arrangements. From the study trends in the countries' domestic arms production will be analysed and inferences drawn on how indigenous production of arms is established.

The Case Studies will examine records from industrialists, industrial consultants, government and research agencies. Sources of data include:
The Defence Export Services Organisation of the UK Ministry of Defence publish data from their database covering the value of new business or new orders placed in a particular year. The data base includes a consideration of a nation's published equipment procurement budget and a judgement is made on the inclusion of part of those published budgets in the defence market statistics for example for air bases, buildings, or for part federal use in anti-drugs, anti-smuggling or anti-slavery. Care has to be taken in interpreting the figures from the DESO database: (a) DESO measure orders received and there are no inputs of negative figures to reflect cancellations of orders, (b) industry tends to measure values of payments on the date of transfer of legal ownership from the supplier to the purchaser and (c) the UK MOD generally measure exports in terms of payments.

- The United States Arms Control and Disarmament Agency (ACDA) publishes an annual report containing detailed data on the world's military expenditure and arms trade.

7.4.3 Survey

The country case studies examine secondary sources of data. The strategy in the survey was to examine the nature of domestic defence production by analysis of information collected from prime sources, i.e. from arms dealers, defence industrialists, military and government authorities in the countries studied, Australia,
Israel, Japan and ASEAN and also arms dealers in Europe and in USA.

7.4.4 Validation Interviews

The purpose of validation interviews with key persons in the strategic weapons procurement business and related fields is to go beyond analysis of data and to seek insights into why certain decisions and trends have been observed.
Chapter 8

Macro Analysis: a mathematical analysis to investigate the relationship between licensed and indigenous production.
8.1 DATA

Data was taken from the SIPRI database (SIPRI, 1993) on the value of trade, licensed production and indigenous production of major weapons over a twenty-five year period. The countries covered were twelve emerging nations, which are listed by SIPRI as developing countries: Argentina, Brazil, Chile, Egypt, India, Indonesia, Israel, Pakistan, Singapore, South Africa, South Korea and Taiwan. The twenty-five year period was from 1965 to 1990.

The set of SIPRI data was derived in a study by SIPRI using one pre-defined process involving a judgement of value being allocated by SIPRI to each weapon system licensed, imported or indigenously manufactured by each of the twelve countries over 25 years. The data is summarised in Table 8.1.
### TABLE 8.1

Table of values of arms production and imports for twelve countries, showing (A) indigenous production, (B) licensed production, (C) imported arms and (D) A+B+C, the total value of arms domestically produced and imported. The values were estimated over twenty five years from 1965 to 1990. The values are estimated in constant 1990 year US million dollars and are taken from the SIPRI arms data base.


<table>
<thead>
<tr>
<th>Country</th>
<th>A (Indigenous)</th>
<th>B (Licensed)</th>
<th>C (Imported)</th>
<th>A+B+C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country 1</td>
<td>Value 1</td>
<td>Value 2</td>
<td>Value 3</td>
<td>Value 4</td>
</tr>
<tr>
<td>Country 2</td>
<td>Value 5</td>
<td>Value 6</td>
<td>Value 7</td>
<td>Value 8</td>
</tr>
<tr>
<td>Country 3</td>
<td>Value 9</td>
<td>Value 10</td>
<td>Value 11</td>
<td>Value 12</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>
8.2. ANALYSIS

The purpose of the analysis is to determine if there exists a correlation between the value of indigenous production in a particular year and the value of licensed production which had taken place before that year (i.e. 0 years previously, 1 year previously, 2 years previously, etc).

The method used was implemented on commercially available Mathcad statistical software. The following procedure was used to examine the data for each of the twelve countries:

Analytical procedure:

1. The data was transposed from rows into columns.
2. The average value of each set was calculated and subtracted from each element in the set.
3. \( E_0 \) represents indigenous production values, less the average value.
   \( E_1 \) represents licensed production, less the average value
   \( E_2 \) represents imported major weapons, less the average value
   \( E_3 \) represents the sum \( E_0 + E_1 + E_2 \).
4. The aim is to look for a correlation between a current year indigenous production and the licensed production "p" years back from that year.
5. A new set of variables \( f_0, f_1, f_2, f_3 \), is generated which ensures that only positive values of p are examined.
6. A variable B is generated. B\textsubscript{1} (subscript m) is the average of all the elements in E\textsubscript{1} except for the last m of them. B\textsubscript{1} (subscript p) is the average value of E\textsubscript{1} except the last p of them.

7. A variable X is generated, such that X\textsubscript{0} is a measure of the variance of E\textsubscript{0}. The covariance is the average product of the deviations of two variables from their respective means (Berry and Lindgren, 1990).

8. The correlation coefficient is the unitless measure obtained from the covariance by dividing it by the product of the standard deviations (Berry and Lindgren, 1990).

Definition of correlation coefficients

The calculation uses correlation coefficients, C, defined as follows:

\( C_0 \) is the correlation coefficient and is the vector containing the correlation coefficients for 0 years back, 1 year back, 2 years back, etc.

\( C_0 \) is the correlation between E\textsubscript{0} and E\textsubscript{1}, i.e. between indigenous and licensed production.

\( C_0(\text{ subscript } p\text{ }) \) is essentially an expected value or an estimate of the value of the average of

\( (\text{ each in the series for the indigenous production minus its average }\)
times

\((each \ term \ in \ the \ series \ for \ licensed \ production \ minus \ its \ average)\)

divided by

\((an \ estimate \ of \ the \ standard \ deviation \ of \ the \ series)\).

9. The numerator of this $C_0(p)$ is the covariance of the two series. The denominator is the square root of the product of the two variances.

8.3. CALCULATIONS FOR EACH COUNTRY

The calculations were carried out for each of the twelve emerging nations. The correlation coefficient algorithms used in the calculation were provided by Marconi Space and Defence Systems Ltd. The calculation for one country, Argentina is shown in Annex 8.3. as an example.
8.4. RESULTS

8.4.1 Table 8.4.1 presents the values of correlation coefficient between indigenous production and licensed production, when the indigenous production is measured N years after the licensed production.

Table 8.4.1 The values of correlation coefficient between indigenous production and licensed production, when the indigenous production is measured "N" years after the licensed production.

<table>
<thead>
<tr>
<th>Number of years, N years</th>
<th>0 years</th>
<th>1 year</th>
<th>2 years</th>
<th>3 years</th>
<th>4 years</th>
<th>5 years</th>
<th>6 years</th>
<th>7 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>0.941</td>
<td>0.325</td>
<td>0.223</td>
<td>0.174</td>
<td>0.291</td>
<td>0.130</td>
<td>-0.079</td>
<td>-0.219</td>
</tr>
<tr>
<td>Brazil</td>
<td>0.482</td>
<td>0.178</td>
<td>0.183</td>
<td>0.444</td>
<td>0.403</td>
<td>0.265</td>
<td>0.160</td>
<td>-0.060</td>
</tr>
<tr>
<td>Chile</td>
<td>0.747</td>
<td>0.846</td>
<td>0.728</td>
<td>0.724</td>
<td>0.606</td>
<td>0.567</td>
<td>0.483</td>
<td>0.123</td>
</tr>
<tr>
<td>Egypt</td>
<td>0.965</td>
<td>0.790</td>
<td>0.590</td>
<td>0.416</td>
<td>0.391</td>
<td>0.374</td>
<td>0.182</td>
<td>-0.067</td>
</tr>
<tr>
<td>India</td>
<td>0.788</td>
<td>0.614</td>
<td>0.487</td>
<td>0.415</td>
<td>0.228</td>
<td>-0.042</td>
<td>-0.275</td>
<td>-0.239</td>
</tr>
<tr>
<td>Indonesia</td>
<td>0.922</td>
<td>0.833</td>
<td>0.776</td>
<td>0.792</td>
<td>0.691</td>
<td>0.624</td>
<td>0.544</td>
<td>0.431</td>
</tr>
<tr>
<td>Israel</td>
<td>0.461</td>
<td>0.409</td>
<td>0.289</td>
<td>0.195</td>
<td>0.114</td>
<td>0.047</td>
<td>-0.046</td>
<td>-0.101</td>
</tr>
<tr>
<td>Pakistan</td>
<td>0.666</td>
<td>0.600</td>
<td>0.557</td>
<td>0.202</td>
<td>0.059</td>
<td>-0.077</td>
<td>-0.206</td>
<td>-0.328</td>
</tr>
<tr>
<td>Singapore</td>
<td>0.679</td>
<td>0.309</td>
<td>0.089</td>
<td>0.271</td>
<td>0.323</td>
<td>0.352</td>
<td>0.190</td>
<td>0.155</td>
</tr>
<tr>
<td>S.Africa</td>
<td>0.436</td>
<td>0.436</td>
<td>0.277</td>
<td>0.206</td>
<td>0.107</td>
<td>0.079</td>
<td>-0.038</td>
<td>-0.010</td>
</tr>
<tr>
<td>S.Korea</td>
<td>0.960</td>
<td>0.877</td>
<td>0.739</td>
<td>0.568</td>
<td>0.370</td>
<td>0.304</td>
<td>0.103</td>
<td>-0.038</td>
</tr>
<tr>
<td>Taiwan</td>
<td>0.875</td>
<td>0.558</td>
<td>0.294</td>
<td>-0.027</td>
<td>-0.238</td>
<td>-0.311</td>
<td>-0.317</td>
<td>-0.296</td>
</tr>
</tbody>
</table>

Source: Table by current author showing values of correlation coefficients calculated using Mathcad analytical software.
8.4.2 Examination of the results

For each of the twelve countries there are striking similarities. The value of indigenous production correlates to the current year or recent years licensed production, and the correlation tails off to insignificance i.e. below the value 0.4, by seven years in eleven of the twelve countries, the exception being Indonesia.

The highest value of correlation is seen with the current year, i.e. \( N = 0 \) in eleven of the twelve countries, the exception being Chile. In the case of Chile the current-year correlation is never the less high (measuring 0.747), and a one year gap, \( N = 1 \), gives the highest correlation for that country, at 0.876.

A conclusion is that in the emerging nations the value of the indigenous production of arms is not dependent on the value of licensed production in previous years, but is related to the current year value of licensed production.

8.4.3 Characteristics of indigenous production

In order to investigate why indigenous production would correlate with licensed production, data was collated in Table 8.4.3 on characteristics of indigenous production on each country, and a record made of:

a) the aggregate value of indigenous production, 1965 to 1990, measured in 1990 year values of US$ millions. The data was taken from the SIPRI arms trade data base cited in SIPRI, 1993.
b) the highest value of correlation coefficient for each country, presented in table 8.4.1

c) The number of different weapons categories from ten categories, built indigenously by the country by the year 1990. This record provides a measure of the diversity of the arms industry. The ten categories of weapon are jet aircraft, propeller driven aircraft, helicopters, guided missiles, main battle tanks, armoured vehicles, large calibre artillery, radar, surface warships and submarines. The data was taken from the SIPRI arms trade data base cited in SIPRI, 1993.

d) The first year of production of large calibre artillery by that country. This record provides a measure of the maturity of the arms industry. The data was taken from the SIPRI arms trade data base cited in SIPRI, 1993.
### Table 8.4.3 Characteristic data of indigenous production of twelve countries

<table>
<thead>
<tr>
<th></th>
<th>Correlation coefficient between indigenous and licensed production</th>
<th>Average value of indigenous production, US$millions</th>
<th>Number of different weapon categories built indigenously</th>
<th>First year of indigenous production of large calibre artillery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>0.941</td>
<td>2,997</td>
<td>6</td>
<td>1978</td>
</tr>
<tr>
<td>Brazil</td>
<td>0.482</td>
<td>6,334</td>
<td>7</td>
<td>1969</td>
</tr>
<tr>
<td>Chile</td>
<td>0.747</td>
<td>425</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Egypt</td>
<td>0.965</td>
<td>1,673</td>
<td>3</td>
<td>1981</td>
</tr>
<tr>
<td>India</td>
<td>0.788</td>
<td>20,483</td>
<td>8</td>
<td>1980</td>
</tr>
<tr>
<td>Indonesia</td>
<td>0.922</td>
<td>975</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Israel</td>
<td>0.461</td>
<td>13,204</td>
<td>7</td>
<td>1968</td>
</tr>
<tr>
<td>Pakistan</td>
<td>0.666</td>
<td>69</td>
<td>1</td>
<td>1990</td>
</tr>
<tr>
<td>Singapore</td>
<td>0.679</td>
<td>4,921</td>
<td>1</td>
<td>1986</td>
</tr>
<tr>
<td>S.Africa</td>
<td>0.436</td>
<td>8,517</td>
<td>7</td>
<td>1979</td>
</tr>
<tr>
<td>S.Korea</td>
<td>0.960</td>
<td>4,858</td>
<td>4</td>
<td>1976</td>
</tr>
<tr>
<td>Taiwan</td>
<td>0.875</td>
<td>682</td>
<td>4</td>
<td>1976</td>
</tr>
</tbody>
</table>

Source: Table by current author from data taken from SIPRI arms trade data base cited in SIPRI, 1993.
Figure 8.4.4 First year of indigenous production of large calibre artillery plotted against correlation coefficient between indigenous and licensed production.

(Source: figure by current author)
Figure 8.4.5  Number of different weapon systems categories indigenously produced plotted against correlation coefficient between indigenous and licensed production.

(Source: figure by current author)
Figure 8.4.6  Average value of indigenous arms production over the period 1965 to 1990, measured in millions US $, plotted against correlation coefficient between indigenous and licensed production.

(Source: figure by current author)
8.4.4 The correlation coefficient and the age of the industry.

In order to see if the correlation between indigenous and licensed production was dependent on the age of the defence industry in a particular country, Figure 8.4.4 of the first year of indigenous production of large calibre artillery, was plotted against correlation coefficient between licensed and indigenous production.

The result showed no strong trend.

A conclusion is that the correlation between the value of indigenous production and of licensed production is not dependent on the maturity of the arms industry measured in terms of age of the industry.

8.4.5 The correlation coefficient and the diversity of the defence industry

In order to see if the level of correlation between indigenous and licensed production was dependent on the diversity of the defence industry of a particular country, Figure 8.4.5 of the number of different weapon systems categories indigenously produced was plotted against the correlation coefficient between licensed and indigenous production.

The figure showed no strong trend.

A conclusion is that the correlation between value of licensed and indigenous
production is not dependent on the maturity of the arms industry in terms of the number of weapon system categories indigenously manufactured.

8.4.6 The correlation coefficient and the value of indigenous production

In order to see if the level of correlation between indigenous and licensed production was dependent on the value of indigenous production, Figure 8.4.6 of the average value of indigenous production over the period 1965 to 1990 and measured in 1990 millions US dollars was plotted against the correlation coefficient between indigenous and licensed production.

The figure showed a general trend in that the lower the value of indigenous production, the higher the correlation between indigenous and licensed production. An exception to this trend is India, which has a high level of indigenous production and high level of correlation between indigenous and licensed production.

A conclusion is that in countries which are developing an arms industry the higher the value of indigenous production, the lower the correlation between licensed and indigenous production. A parallel conclusion is that in the countries which are developing an arms industry, the lower the value of indigenous production, the higher the correlation between indigenous and licensed production.
8.5 CONCLUSION

The macro-analysis failed to support the hypothesis that licensed production of arms measured by value results in indigenous production of arms measured by value.

The macro-analysis showed that the value of the indigenous production of arms is not dependent on the value of licensed production in previous years, but is related to the current year value of licensed production. This showed that the value of indigenous arms production is not a result of the value of licensed production, but rather the values of indigenous production and licensed production are both the result of another cause.

If the value of indigenous production had resulted from the value of licensed production then there would have been a meaningful time lag between the value of licensed production and a later value of indigenous production.

The analysis also showed that in the countries with very low values of indigenous production there was very high correlation between licensed and indigenous production. This result would appear reasonable in that countries with highly progressed arms industries and high levels of indigenous production would have industries not so dependent on licensed production and a correlation would be weaker.
Chapter 9

Case studies of the development of arms production in three countries, Australia, Israel, Japan and in ASEAN
9. CASE STUDIES OF THE DEVELOPMENT OF ARMS PRODUCTION IN
THREE COUNTRIES, AUSTRALIA, ISRAEL, JAPAN AND IN ASEAN.

This section examines the setting up of arms production in three countries Australia, Japan, and Israel and the countries of the Association of South-East Asian Nations, ASEAN. The countries examined provide a range of military settings, from a country with no major threats to a country in an almost perpetual state of war and to an area overshadowed by an arms race, from a major industrial power to countries with limited industrial development and from financially secure countries to countries with struggling economy.

Australia does not face major military threats but has to be aware of the growing economic and military strength of South East Asia, India, Japan and China. Australia was ranked sixteenth in the world in the level of countries' military expenditures in 1991 (U.S.Arms Control and Disarmament Agency, 1992).

Japan is one of the world's major industrial powers and has the capability to manufacture nearly all of its military equipment. Japanese industry produces aircraft, ships, engines, military vehicles, small arms, missiles and electronic equipment (Congress of the United States, Office of Technology Assessment, 1991). Japan is a pacifist nation under Article 9 of its constitution but has become a major military power and in 1991 had the eighth largest military expenditure and twenty-fourth largest number of armed forces in the world (U.S.Arms Control and Disarmament Agency, 1992).
Israel has been in an almost perpetual state of war since its independence in 1948, having fought the Egyptians, Jordanians, Syrians, Palestinians, Lebanese and Iraqis (Europa World Yearbook, 1991). Israel, surrounded by hostile neighbours has accumulated one of the largest military arsenals in the world with highly sophisticated weapon systems. In 1991 Israel had the 25th largest military expenditure in the world (U.S. Arms Control and Disarmament Agency, 1992).

The ASEAN countries are among the world's most highly successful emerging and newly developed nations (Europa World Yearbook, 1991). The military expenditure has followed the economic progress of the area and the countries have expanded and improved their military inventories (Cloughly, 1995). The Asia-Pacific region has in the 1980s and 1990s became strategically unstable with long-standing territorial disputes which showed no signs of being resolved and with problems of insurgency and piracy. The growing arms procurements have been described as countries' military modernisation programmes (Cloughly, 1995, Karniol, 1995) but many sources have described the build up of arms inventories in Asia as an arms race (Huxley, 1995, Klare, 1993, and Richardson, 1995 as sited by Willet, 1996).

9.1. AUSTRALIA

Australia is a parliamentary democracy in which the British monarch has executive powers of the Federal Government (Europa World Yearbook, 1991). The country has not faced major military threats either internal or external since World War II (Lonhardt, 1995). Australian national security is strongly linked with the military
status of the neighbouring countries of southern Asia and particularly Indonesia, Malaysia and Singapore (Australian Government, 1989).

During World War II Japanese forces swept through Asia and although they failed to breach the US and Australian defences and did not invade Australia, they made more than fifty bombing raids on Darwin in the Northern Territory between February 1942 and November 1943 (Lonhardt, 1995). Japan was eventually defeated in Myanmar (previously Burma), Borneo and Papua New Guinea and the threat to Australia decreased. There was minimal military activity in Australia during the cold war years following World War II. Australian forces were deployed overseas in the 1950s to Korea and then to Vietnam in the 1960s (Europa World Yearbook, 1991). In the late 1970s and early 1980s the importance of defence of Northern Australia was again brought to focus. In 1969 the US President Nixon made an announcement that the US allies in the Asia-Pacific region would have to mount their own defences against future military threats (Cheeseman, 1993). At that time the government realised that most of Australia's military equipment was imported from USA and it was decided that effort should be directed to reduce the level of dependence on military imports and increase the level of domestic defence production. Various strategies including offsets, technology transfers, government subsidies and equipment procurement policies were pursued to achieve a viable domestic defence industry.
9.1.1 Offsets

Cheeseman, 1993 described how in the 1970s and early 1980s there was emphasis on offset deals in order to develop military industrial skills in Australian companies. Australian industry complained that offset deals resulted in very little benefit because the overseas suppliers directed effort to minimising offset obligations and the cost of satisfying them and by structuring the offset deal such that Australian industry could not meet the offset requirements. Foreign companies set up local subsidiaries and would undertake technology transfer only to their own subsidiaries and not to Australian companies which they perceived as potential competitors. In the 1970s and 1980s the Australian government took steps to monitor the success of offset deals and also revised its offset policies which did lead to slight improvement (Table 9.1.1a). Table 9.1.1a shows the value of offset orders placed on Australian companies by overseas suppliers. Table 9.1.1b shows the level of offset deals negotiated by the USA on military sales to five countries including Australia. The table shows that the offset deals negotiated by Australia provided a proportionately lower level of offset business than the deals negotiated by other countries, Canada, Israel, Spain and the United Kingdom. There was great disappointment as the expected benefits of offset programs to Australian industry failed to materialise. Table 9.1.1c shows the steps taken by the government in an attempt to increase the benefit of offset deals.
Table 9.1.1a: Value of offset orders placed on Australian industry by overseas suppliers.

<table>
<thead>
<tr>
<th>YEAR</th>
<th>VALUE OF OFFSET ORDERS PLACED AS PERCENTAGE OF OFFSET OBLIGATIONS.</th>
<th>VALUE OF OFFSET ORDERS PLACED AS PERCENTAGE OF ELIGIBLE CONTRACTS VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970 To 1984</td>
<td>25%</td>
<td>7%</td>
</tr>
<tr>
<td>1980 To 1986</td>
<td>29%</td>
<td>NOT STATED</td>
</tr>
<tr>
<td>1981 to 1988</td>
<td>36%</td>
<td>10%</td>
</tr>
</tbody>
</table>

Source: table by current author from data presented by Cheeseman (1993)

Table 9.1.1b: Value of offset deals set up by USA on USA military sales to various countries including Australia, showing the value of the sales over a five year period, 1980 to 1984, the value of the offset obligation and the value of offset actually implemented as a percentage of the offset obligation.

<table>
<thead>
<tr>
<th>RECIPIENT COUNTRY</th>
<th>VALUE OF USA MILITARY SALES, $ MILLIONS, FROM 1980 TO 1984</th>
<th>VALUE OF OFFSET OBLIGATION, $MILLIONS, &amp; AS PERCENTAGE OF VALUE OF THE SALE</th>
<th>VALUE OF OFFSET IMPLEMENTED, $ MILLIONS, &amp; AS PERCENTAGE OF THE OFFSET OBLIGATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>$3366.5 M</td>
<td>$1156.7 M (34%)</td>
<td>$121.6 M (14%)</td>
</tr>
<tr>
<td>Canada</td>
<td>$2632.1 M</td>
<td>$2810.6 M (107%)</td>
<td>$785.8 M (30%)</td>
</tr>
<tr>
<td>Israel</td>
<td>$4163.4 M</td>
<td>$1477.4 M (35%)</td>
<td>$413.1 M (28%)</td>
</tr>
<tr>
<td>Spain</td>
<td>$2906.1 M</td>
<td>$2404.0 M (82%)</td>
<td>$113.5 M (5%)</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>$265.7 M</td>
<td>$224.0 M (85%)</td>
<td>$111.9 M (50%)</td>
</tr>
</tbody>
</table>

Table 9.1.1c: Recommendations and actions by the Australian Government to improve the success of offsets.

<table>
<thead>
<tr>
<th>YEAR</th>
<th>ACTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984</td>
<td>The 1984 Report of the Committee of Review on Offsets (the Inglis Committee) reported on the level of offsets in the period 1970 to 1984. Proposed that offsets should encompass technology transfers, research and development and training. Recommended regular offset policy updates by government, and stronger enforcement of offset commitments.</td>
</tr>
<tr>
<td>1986</td>
<td>Government implemented main body of recommendations of Inglis Committee.</td>
</tr>
<tr>
<td>1987</td>
<td>Joint Committee of Public Accounts published the Implementation of the Offsets Program, and found the compliance of offset obligations had improved only to 29%.</td>
</tr>
<tr>
<td>1989</td>
<td>Government revised guidelines on offsets as part of a broad review on its defence industrial policy.</td>
</tr>
</tbody>
</table>

Source: table by current author from data presented by Cheeseman (1993)

There was limited success in offsets despite the efforts by government and Australian industry. Overseas suppliers were fulfilling only one third of their offset obligations in the period 1981 to 1988 as shown in Table 1.1a and in Table 9.1.1c. The Australian government's Defence and Industry Policy report (Department of Industry, Technology and Commerce, November 1992) pointed out that in the 1980s there were first unenforceable offsets, then enforceable offsets and finally an industry involvement program with only a minor element of offset involvement.
9.1.2 Government Policy on Defence Industry

The Australian Department of Defence report entitled Defence Policy and Industry, November 1992, stated that Australia's defence policy was based on self reliance and Australia's defence industry was considered as the fourth arm of defence after the three armed services of the Navy, Army and Air Force. The report pointed out that Australian industrial involvement in defence procurement contracts had tripled in the previous decade from A$476 million p.a. in 1982/83 to A$1400 million p.a. in 1991/92.

Dibb (1992) in his report entitled Strategic Priorities for Australian Industry pointed out that Australia had not based its defence policy to meet the threat of the Warsaw Pact countries, and with the end of the cold war had no requirement for a peace dividend of reduced military expenditure. Australia had recognised the uncertainties of dependence on allies for military combat support and the need to build up military self-reliance. The 1990 Strategic Planning Document stated that the defence relationship with South East Asia and improvement of the defence relationship with Indonesia in particular were important policy issues for the next decade. Table 9.1.2a summarises the Government's activity relating to its defence industrial policy, and Table 1.2b summarises the Government assistance to the defence industry to increase the level of exports. In 1984 the Department of Defence opened the Office of Defence Production (ODP) to make government owned manufacturing operations more competitive. The government had to take action to protect projects and capabilities which were identified as essential but which were not commercially
viable, and in 1985 a funding scheme was provided for uncompetitive contracts relating to repair and refurbishment work, strategically important contracts, and contracts which would subsequently lead to valuable export contracts. In 1986 the Australian government set up a support structure to assist defence exports. The Department of Defence facilities and personnel were allocated to assist in marketing, evaluation and testing of equipment, the provision of spares and other support functions. In 1988 new policy guidelines were introduced to simplify defence equipment export approval. The administration of export approval was simplified and streamlined to a faster process,
Table 9.1.2a: Government Activity relating to Policy on the Australian Defence Industry

<table>
<thead>
<tr>
<th>Date</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984</td>
<td>The Department of Defence opened the Office of Defence Production (ODP) to make government owned manufacturing operations more competitive.</td>
</tr>
<tr>
<td>1985 to 1989</td>
<td>Government funding was provided for uncompetitive contracts relating to repair and refurbishment work, strategically important contracts, and contracts which subsequently lead to valuable export contracts.</td>
</tr>
<tr>
<td>1986</td>
<td>1986 report published by Paul Dibb &quot;Review of Australia's Defence Capabilities&quot;, recommended 1) Maximise self-sufficiency in repair and maintenance, and software support. 2) Maximise self-sufficiency on high usage spares and ammunition when there is not excessive cost penalty. 3) Retain indigenous manufacture where it is competitive, ii) for unique Australian requirement, or iii) the manufacturing activity will provide the capability in subsequent maintenance and upgrade.</td>
</tr>
<tr>
<td>1987</td>
<td>The main body of recommendations in Dibbs 1986 review were encompassed in 1987 Government White Paper which defined the government policy for the defence industry. In particular government defence manufacturing facilities were to be rationalised, run on a commercial basis or privatised, and Australian industry would be encouraged to increase its share of domestic and world arms markets. Australian civilian manufacturing industry would be encouraged to establish and maintain an arms manufacturing capability in preference to setting up a highly subsidised defence industry.</td>
</tr>
<tr>
<td>1986 to 1987</td>
<td>The government owned Aerospace Technologies of Australia (ASTA) took over the Government Aircraft Factories. A private consortium, Australian Marine Engineering Corporation, AEC, purchased the Williamstown Dockyards. AEC won the highly profitable contract in 1989 to build the ANZAC frigate under licence from Germany.</td>
</tr>
<tr>
<td>1989</td>
<td>The Government Office of Defence Production (ODP) became an independent company Australian Defence Industries (ADI) which was tasked with becoming commercially viable.</td>
</tr>
<tr>
<td>1989</td>
<td>The government announced i) a A$25billion defence equipment procurement budget over the following 15 years, ii) submarines, frigates and other developed items were to be manufactured under licence in Australia and not imported, and iii) contracts for naval craft would be placed for significant numbers and not ordered in ones and twos.</td>
</tr>
</tbody>
</table>

Source: table by current author from data presented by Cheeseman (1993)
Table 9.1.2b: Government support to increase the level of defence exports

<table>
<thead>
<tr>
<th>Year</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td>Government Department of Defence facilities and personnel were allocated to assist in marketing, evaluation and testing of equipment, and the provision of spares held in stock and support of equipment purchased and in-service.</td>
</tr>
<tr>
<td>1988</td>
<td>New export policy guidelines were published by the government. The 1988 guidelines for arms exports relaxed the 1975 guidelines considerably. The 1988 guidelines gave responsibility for export policies to the Department of Defence, and not to both the Department of Defence and the Department of Foreign Affairs and Trade as previously. The administration of export approval was simplified and streamlined to a faster process, and the DoD was required to justify any refusal of export licences on a case-by-case basis.</td>
</tr>
</tbody>
</table>

Source: table by current author from data presented by Cheeseman (1993)

Several of the world's leading arms suppliers opened subsidiary or joint venture companies in Australia in order to retain a share of the Australian defence market (Jane's International Defence Directory, 1996). Examples are

British Aerospace Australia Ltd, (subsidiary of British Aerospace, UK)
Caterpillar of Australia Ltd (Caterpillar Inc, USA)
Cray Communications Ltd (Cray Electronics Holdings Ltd, UK)
Ericsson Defence Systems Pty Ltd, (Ericsson Radio Systems, Sweden)
GEC-Marconi Australia Pty (General Electric Company, UK)
General Motors - Holden Automotive Ltd (General Motors Corp, USA)
Hawker de Havilland Ltd, (BTR plc, UK)
Hewlett-Packard Australia Ltd (Hewlett Packard Corp, USA)
Pains-Wessex (Australia) Ltd, (Chemring Group, UK)
9.1.3 **Licensed and Indigenous Defence Production**

The Australian defence equipment expenditure over the decade 1984 to 1993 remained steady at around A$2250 million per annum but the proportion manufactured in Australian industry increased from 30% in 1983/4 to 65% in 1992/3, an improvement directly resulting from Government industrial policy according to the Department of Defence report, November 1992. The largest sector of defence expenditure was naval, which represented 32% of total defence expenditure in 1986/87. The Department of Defence report, November 1992 did differentiate between imported and Australian manufactured defence equipment, but did not detail the share between indigenous and licensed production.

Examination of shipbuilding records shows that in the thirty years up to 1995 about one third of Australian major warships were imported but from 1995 all current and future Australian naval warships were being or were to be built in Australia. Sharpe (1995) in his Jane's World Warship Construction Special Report showed that of twenty warships under current construction in 1995 and of twelve planned Australian
warships, none were imported and all were being or were to be constructed in Australia. Examination of the operational warships (and therefore procured before 1995) shows the proportion of naval vessels which had previously been imported was about one third for the main warships and about one tenth for the smaller ships (survey ships, general purpose, service forces ships and army watercraft). This data which has been summarised in Table 9.1.3a confirms that Australian industry is increasing its share of its home defence market (by measure of the numbers of items of equipment being built). This finding is supported by examination of the Australian Department of Defence report (November 1992) which measured an increase in the domestic share of the home defence market by value and not by numbers of equipment being built. The defence equipment expenditure in Australian industry increased from $600 million per annum (27% of equipment expenditure) in 1984-85 to $1600 million (60% of equipment expenditure) in 1992-93.
Table 9.1.3a  Australian naval warship construction, Australian built and imported.

<table>
<thead>
<tr>
<th>Australian Naval Warships</th>
<th>Quantity Australian Build</th>
<th>Quantity imported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planned future builds, after 1995</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Current builds in 1995</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>Operational naval ships in 1995,( detailed in Jane's Fighting Ships 1994-95)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major warships:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Submarines Collins</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Submarines Oberon</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Destroyers DDG-2</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Frigates FG-7</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Frigates River Class</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Light Forces</td>
<td>16</td>
<td>1</td>
</tr>
<tr>
<td>Mine Warfare Forces</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Amphibious</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Smaller warships:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Survey ships</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>General Purpose</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Service forces ships</td>
<td>16</td>
<td>5</td>
</tr>
<tr>
<td>Army watercraft</td>
<td>33</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: Table by current author from data presented by Sharpe, 1995 (Jane's World Warship Construction Special Report) and Sharpe, 1994 (Jane's Fighting Ships, 1994-95).

Table 9.1.3b shows the major licensed production agreements held by Australian industry between 1981 and 1989. There are three major shipping contracts, two aircraft and one towed gun contracts.
Table 9.1.3b  Licensed production of major conventional weapons

<table>
<thead>
<tr>
<th>Date of licence</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td>The quantity 65 covers: 2 for direct purchase 17 for assembly 48 for local licensed production</td>
</tr>
<tr>
<td>1982</td>
<td>The quantity 73 included 2 for direct purchase 71 for licensed production</td>
</tr>
</tbody>
</table>

Submarine Corporation at an early stage in the programme while the first of the six submarines was still under construction (International Defence Review, June 1992).

The licensed production of a major military system results in the flow down of substantial military contracts within the country's defence industry. Examination of the build under licence of the Collins class submarine shows that of the total contract value A$4.9 billion, seventy per cent of the platform (the ship) work and forty five percent of the combat system (system within the ship) work would be undertaken in Australia (Australian Submarine Corporation, 1994). Very advanced and complex systems continued to be imported for example the surface to surface Harpoon missiles from McDonnel Douglas in USA, the Argo radar support measures and the optronic masts from the UK company, Pilkington Optronics (Sharpe, 1995). Examples of major contracts for the Collins submarine components and systems awarded to Australian industry include:

- steel and heat treatment for the hull sections, Bissalloy Company, New South Wales (International Defence Review, 1 June 1992)
- manufacture and assemble of simulators, Clough Engineering, Perth (International Defence Review, 1 January 1990)
- simulator system design, Computer Sciences of Australia (International Defence Review, 1 January 1990)
- documentation for simulator, Ical of Australia (International Defence Review, 1 January 1990)
- Quality assurance and testing of simulator, Qantas of Australia
Other contracts to Australian industry evolve from major procurement programmes such as the Collins submarine programme, for example the Royal Australian Navy decided to establish a submarine support infrastructure in Western Australia specifically for the Collins submarines (Australian Submarine Corporation, 1994) including:

- a submarine training and system centre
- Underwater Tracking Range
- Underwater Noise Radiation Range
- Magnetic measurement Range and magnetic treatment range.

which involved substantial procurement packages awarded to Australian industry. Rockwell Systems Australia for example were awarded a contract value A$11 million for the design and supply of the magnetic test and magnetic treatment range.

In examining whether licensed production leads to indigenous production in the case of major defence platforms such as warships, the following points are considered:

1. A submarine designer company such as the Swedish company Kockums, designs a new class of submarine about every 5 years (Australian Submarine Corporation, 1994). The operational life of a submarine is nominally thirty years
Chapter 9

(International Defence Review, 1 June 1992) and a country such as Australia would seek to renew its fleet after thirty years, by which time submarine design and production would have progressed by six generations of technology. A country such as Australia would gain valuable state-of-the-art technology expertise by licensed production and following the production phase could retain a degree of technical advance through carrying out upgrades and maintenance programmes. After a time span of thirty years or so when fleet replacement is necessary, the country has to assess again the options of licensed or indigenous production or imports: it may be the case that indigenous production although politically attractive in terms of job creation does not provide the best option commercially or technically. In the case of a major platform it is not necessarily the case that licensed production will be followed by indigenous production on the next occasion.

2. In high technology production it is extremely difficult to miss out a generation of technology and succeed in innovative design. State of the art designs evolve in incremental performance steps and are supported by extensive research and development (Australian Submarine Corporation, 1994). The result of attempting bold and innovative designs in shipbuilding were seen in the case of stealth warships in the 1990s. The scientifically designed profiles provided low radar cross sections and therefore were more difficult to detect by radar, but the ships structures were not strong and they cracked (Forecast International, 1996). Examples of stealth designed major warships include the French La Fayette frigates and the UK Type 23 frigates (Sharpe, 1995)
3. The Australian Department of Defence Report, November 1992, pointed out that cost saving was not a major factor in licensed manufacturing and some military procurements involved additional cost where Australian sources were chosen. The report considered that the additional cost was recouped by the life cycle cost advantages from domestic support and maintenance.

9.1.4 Conclusion

1. Following an announcement in 1969 by the President of the USA that U.S. allies in South East Asia would have to mount their own defences against military threats, it was realised that Australian forces were nearly wholly dependant on imports for defence equipment and the decision was made to build up the capability of Australian defence industry. The Government undertook a sequence of measures to increase self-reliance in arms. It was hoped that the introduction of offset deals in the 1970s on arms imports would provide benefit to Australian industry but the results in terms of quantity and content of offset work proved disappointing in terms of technology transfer or commercial gain. The Australian Government announced that its defence was based on a policy of self-reliance and the Government took steps to strengthen the domestic defence industry in the support and promotion of defence exports and in scheduling a procurement plan designed to maximise Australian industrial involvement. Several of the world's major arms contractors set up subsidiary or joint venture companies in Australia in order to retain or gain a share of the Australian defence market.
2. Manufacture under licence has played a major role in strengthening the Australian defence industry. Major platforms and systems are manufactured under licence but highly complex systems such as missiles which are not available in Australia continued to be imported.

3. Within or associated with the licensed manufacture programmes there are several substantial indigenous manufacture and support contracts. The value of subcontracts which are carried out by domestic industry for a licensed production programme are not readily visible and therefore a database collating the value of indigenous and licensed production may miss a proportion of the indigenous content of a defence programme.

4. Australian Department of Defence figures show that following the implementation of a self-reliance policy and continuing the policy of licensed production, the share of arms procurement built in Australia has increased from one third to two thirds in the decade from 1983/4 to 1992/3.

5. The licensed production of a major system such as a submarine or warship does not necessarily lead to indigenous production of a similar type of system when replacements are due, which could be after a period of up to thirty years. The licensed production does provide (a) opportunities for indigenous production of the associated systems and subsystems such as communications, command systems, weapons control etc. at the same time as the main licensed production, (b) provides the skills and puts into place the technology infrastructure in the
domestic industry and (c) also provides the opportunity for support, maintenance
and upgrade work for the operational lifetime of the equipment which could be
up to thirty years.

9.2. ISRAEL

Israel is a parliamentary democracy with a constitutional government, a president as
the ceremonial head of state and a prime minister as executive head of government.
The survival of Israel, surrounded by hostile neighbours, has resulted from its
prodigious military strength. Due to the continued hostilities in the Middle East
Israel has accumulated one of the largest military arsenals in the world with highly
sophisticated weapon systems. Since its independence in 1948, the country has been
in an almost perpetual state of war, the Israelis having fought the Egyptians,
Jordanians, Syrians, Palestinians, Lebanese and Iraqis. Israel receives about $1.8
billion annually in military grants from the USA.

The Israeli defence industry meets most of the requirements of the armed forces and
also achieves a high level of exports, estimated at $237M per year during the period
The arms exports have been an important foreign exchange earner, ranked third
9.2.1 Embargoes

Table 9.2.1 History of arms embargoes against Israel

<table>
<thead>
<tr>
<th>Event</th>
<th>Embargo and reaction by Israel</th>
</tr>
</thead>
<tbody>
<tr>
<td>1929 Arab anti-Jewish riots</td>
<td>Jews were not able to obtain weapons but the Palestinian Arab population was able to procure weapons. Jewish workshops started to produce small arms and ammunition; the network of workshops developed Ta'As which became the Israeli Military Industries, IMI.</td>
</tr>
<tr>
<td>1948 war. The British terminated the Palestinian Mandate. Jewish leaders proclaimed the State of Israel. Arab states sent military forces into Palestine. Hostilities continued until a ceasefire in January 1949.</td>
<td>There was a series of arms embargoes against the Jews before and during the 1948 war. The USA, UK and France continued the arms embargo after the 1948 war. The UK continued to supply arms and training support to Iraq and Egypt. Israel increased its efforts to import and to build up its arms industry.</td>
</tr>
<tr>
<td>1955, USSR began supplying Egypt with advanced weapons.</td>
<td>1956 to 1967 France supplied Israel with advanced weapons and materials for a nuclear reactor at Dimona. In 1956 Israel started its aircraft industry by setting up aircraft maintenance facilities, Bedek. The armour industry also started by maintaining and refurbishing the Sherman tanks. Following the Suez War in 1956 Israel started licensed production of aircraft, the French Fouga Magister jet trainer, guns and rifles from Belgium, aircraft engines from the French company Turbomeca, and mortars from the Finnish company Tampella. Israeli engineers participated in the design of aircraft and ships being purchased from France.</td>
</tr>
</tbody>
</table>

In 1956 Egypt nationalised the company operating the Suez Canal. In October 1956 Israel attacked Egypt and occupied the Gaza Strip and the Sinai Peninsula. In 1957 the USA and the UN pressured Israel into evacuating these areas and the United Nations Emergency Force, UNEF, was established in Sinai.
The Six-Day War. In May 1967 the United Arab Republic, Egypt, negotiated the withdrawal of UNEF from Sinai, and the Egyptian forces closed the Straights of Tiran to Israeli ships thus blockading the Israeli port, Eilat. Israel attacked Egypt and other Arab countries in what became known as the Six-Day War.

The Six-Day War in 1967 caused the French to impose an embargo on arms to Israel. Items of undelivered orders (gunboats, 50 Mirage fighter aircraft) were withheld. New orders were barred.

The UK supplied two Centurion tanks for evaluation prior to the 1967 war, but after the war refused to supply in quantity. West Germany started to supply Israel with M48 tanks but following pressure from Arabs an embargo was imposed. The USA became Israel's only supplier.

Israel decided to give increased priority to developing its arms industry to remove the undesirable dependence on foreign suppliers.

<table>
<thead>
<tr>
<th>1968 to 1970. Two year War Of Attrition between Egypt and Israel in the Suez Canal zone. Ended August 1970</th>
<th>The USA Nixon administration withheld approval for the sale of aircraft to Israel while imposing political pressure on Israel during the War of Attrition.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The USA Reagan administration delayed arms sales and deliveries to Israel in response to:</td>
<td>The USA made the supply of weapons conditional on the willingness of Israel to accept a ceasefire to the Yom Kippur War.</td>
</tr>
<tr>
<td>i) Israel's attack on Iraq's nuclear reactor, Tammaz-1, June 1981.</td>
<td>During the 1970s and 1980s the Israeli arms industry grew exponentially.</td>
</tr>
<tr>
<td>ii) Israel's annexation of the Golan Heights, December 1981.</td>
<td></td>
</tr>
<tr>
<td>iii) Israel's invasion of Lebanon, June 1982.</td>
<td></td>
</tr>
</tbody>
</table>


Table 9.2.1 shows the political pressures imposed on Israel which had an impact on arms supply and procurement and lists the arms embargoes imposed against Israel by the supplier countries. The origins of the Israeli arms industry are found in the Jewish workshops which produced small arms and ammunition decades before.
the proclamation of the State of Israel. In the 1929 Arab anti-Jewish riots Jews had 
not been able to obtain weapons but the Palestinian Arab population were able to 
procure weapons. The network of workshops developed into Ta'As which became 
the Israeli Military Industries, IMI (Steinberg, 1986).

Table 9.2.1 shows Israel was subjected to more than nine arms embargoes by the 
USA, France, UK and Germany in the forty years since the proclamation of Israel 
in 1948. Israel's response to the embargoes was to seek other suppliers and to 
increase the level of self sufficiency by developing and expanding its own arms 

By the 1990s Israel has built up a sophisticated arms industry manufacturing fighter 
aircraft, transporters, trainer aircraft, reconnaissance aircraft, remotely piloted 
vehicles, fast patrol boats, missiles, tanks, military land vehicles, munitions and wide 
range of sophisticated electronic and electro-optical systems (Forecast International, 
1991). In the early 1970s Israel started to promote the export of weapons. 
Government policy was to use exports of weapons for political and economic gain 
and in the decade 1980 to 1990 Israel exported arms to more than fifty countries. 
Forecast International (1991) also reported that Israel exports large numbers of Soviet 
arms captured from the Palestine Liberation Organisation in Lebanon. The list of 
captured arms includes 290 Russian tanks, 216 armoured vehicles, 10,000 tons 
artillery, 40,000 mortars, 5,700 Katyusha rockets, 19,000 hand grenades, 24,000 rifles 
and 18,950 hand grenades.
Israel has established a strong arms trade with China (Forecast International, 1991), and has exported missiles, tanks, tank barrels and military technology. Israel has denied reports that the electronics system for the Israeli LAVI fighter aircraft which was developed with USA technology was transferred from Israel to China and installed on the Chinese J-A-2 fighter aircraft without USA approval. Forecast International (1994) reported that Israel and China agreed a number of joint ventures in 1988. Israel was very concerned about negotiations between China and Saudi Arabia for the supply of 230 Chinese CSS-3 intermediate range ballistic missiles to Saudi Arabia and Israel attempted to influence China by agreeing to a series of joint developments involving the Israeli companies Elbit Computers, Elisra, Tadiran, El-Op, Rafael and ELTA and Chinese companies and research institutes. The joint developments have been described as the modification of Israeli equipment for China. In 1992 China and Israel agreed a series of ventures between the Israeli Export Institute and SIBAT, the Israeli Foreign Defence Assistance and Defence Export Organisation and CATIC, the China National Aero-Technology Import and Export Corporation. One of the transfers resulting from this agreement was the supply to China of Israeli ELL-8300 signals intelligence equipment which closely resembled a USA system installed on USA intelligence surveillance aircraft. Israel had legally procured USA surveillance aircraft equipped with electronic intelligence equipment. Unattributable sources reported that Israel back-engineered the intelligence equipment from the USA RC135 reconnaissance aircraft.
9.2.2 Israeli Tank Industry

When Israel was formed in 1948 the military had French Hotchkiss, British Cromwell and American Sherman tanks (Steinberg, 1986). In 1954 Israeli technicians were transferred to the Bourges Arsenal in France to design turret mountings for the US Sherman tank with a French tank gun. By 1956 Israeli workshops were building M50 Mark 1 Sherman tanks from M4A4 hulls and French turret castings (Foss, 1986). These tanks were used in the 1956 war when Egypt nationalised the company running the Suez Canal and Israel attacked Egypt and occupied the Gaza Strip and the Sinai. With the benefit of combat experience the Israelis began to improve the tank design for their operational requirement and implemented modifications to the tracks and suspension and replaced the engine and the gun. Further designs resulted in the M51 tank which was used in the pre-1967 border conflict with Syria, the 1968-70 War of Attrition and the 1973 Yom Kippur war.

From their battle experience of 1967 Israel decided to direct effort first to armour protection, secondly to firepower and thirdly to mobility. The USA contributed over $100M towards the development and production of the Merkava main battle tank. The Merkava was first delivered in 1979 and used in battle in 1982 in the invasion of Lebanon. The Israelis were world leaders in the development of reactive armour to counter armour-penetrating missiles. The Merkava's machine gun was manufactured in Israel under licence from the FN company in Belgium. In the 1973 Yom Kippur War several Israeli tanks ran out of ammunition so the design of the Merkava was adjusted to accommodate an increased ammunition supply space.
9.2.3 Israeli Aircraft Industry

Prior to the mid 1950s Israel sent its aircraft to France for maintenance and servicing. The Israeli aircraft industry began with the setting up of maintenance facilities, known as Bedek Aviation which was founded in 1953 as a unit within the Israeli Ministry of Defence. In 1967 Bedek ceased being part of the Ministry and became a Government owned corporation, its name being changed to Israel Aircraft Industries on 1st April 1967 (Jackson, 1995).

In 1956 after the Suez War Israel began licensed production of aircraft, the Fouga Magister jet trainers licensed by France. Israel also provided engineers to participate in the design of Mirage aircraft purchased from France. After the Six Day War in 1967 the French imposed an arms embargo on Israel, refusing to deliver 50 Mirage fighter aircraft which had been previously ordered. Israel's response was the production by IAI of a fighter aircraft, the Nesher, which was an Israeli reverse engineered version of the French Mirage (Jackson, 1995). The production of the Nesher involved obtaining forgings and pre-formed panels from USA and the informal procurement of drawings from France (Jackson, 1995). The next aircraft to be produced in Israel was the Kfir delta-wing fighter aircraft, the design of which was also based on the Mirage, and which contained an estimated 40% imported components. The aircraft's engine, General Electric J79 engine, was of USA design and this resulted in US export restrictions on the Israeli aircraft. In order to avoid the export restrictions Israel negotiated the purchase of French SNECMA engines for the Kfir in 1989. Israel has succeeded in exporting the Kfir to USA, Chile, Colombia and Ecuador (Jackson, 1995).
Israel requested a part manufacture under licence agreement from the USA for the F-16 fighter aircraft but this was refused because the USA was concerned about the loss of technology. Yitzak Rabin, (Chief of Staff, Defence Minister and Prime Minister) had argued that the best strategy for Israel was the import of major weapons platforms such as aircraft together with fitting out the platforms with indigenously produced components and systems (Congress of the United States Office of Technology Assessment, 1991).
### Table 9.2.4.1 Missile manufacture in Israel

<table>
<thead>
<tr>
<th>Missile</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gabriel ship launched and air launched</td>
<td>Highly successful export to more than seven countries. South Africa</td>
</tr>
<tr>
<td>missile. Developed in 1960s.</td>
<td>took a licence to manufacture in 1984. Taiwan took out a licence to</td>
</tr>
<tr>
<td></td>
<td>manufacture in 1978.</td>
</tr>
<tr>
<td>Shafrir air to air missile. First production</td>
<td>Exported to Chile, South Africa, Taiwan. This is reported to have been</td>
</tr>
<tr>
<td>1965.</td>
<td>based on the design of the USA Sidewinder to which there are close</td>
</tr>
<tr>
<td></td>
<td>similarities.</td>
</tr>
<tr>
<td>Popeye anti-ship missile</td>
<td>In USA negotiated licensed production of the Israeli designed Popeye.</td>
</tr>
<tr>
<td>Python 3 air to air missile, marketed in 1981</td>
<td>This design is also reported to closely resemble the USA Sidewinder.</td>
</tr>
<tr>
<td>Barak 1 ship defence missile, developed by</td>
<td></td>
</tr>
<tr>
<td>IAI and Rafael, developed late 1980s.</td>
<td></td>
</tr>
<tr>
<td>ADAMS air defence missile by Rafael, 1985</td>
<td></td>
</tr>
<tr>
<td>Mapats portable anti-tank missile, produced</td>
<td>The Israeli design is based on the Soviet Sagger missile and the USA</td>
</tr>
<tr>
<td>in 1985 by IMI</td>
<td>Hughes TOW missile. The warhead and propulsion system resemble that of</td>
</tr>
<tr>
<td></td>
<td>the USA TOW.</td>
</tr>
<tr>
<td>Nimrod air or ground launch laser guided</td>
<td></td>
</tr>
<tr>
<td>missile, developed by IAI in the 1980s</td>
<td></td>
</tr>
<tr>
<td>Arrow anti-tactical ballistic missile, under</td>
<td>Joint development by Israel and USA as part of the US Strategic Defence</td>
</tr>
<tr>
<td>development 1990</td>
<td>Initiative program. US funding 80 to 90 %.</td>
</tr>
<tr>
<td>Jericho ballistic missile, nuclear/conventional. Being developed before 1990</td>
<td></td>
</tr>
</tbody>
</table>

Source: table by current author from data in Forecast International, 1991

Table 9.2.4.1 shows the range of missiles manufactured by Israeli industry. The list demonstrates the sophisticated level of Israeli technology. Missile manufacturing also
shows that Israel has used joint development and joint funding with the USA to develop military technology, has been capable of using state of the art technology from other countries to develop Israeli designs and has built up a strong export trade. Other countries have negotiated licensed production of the Israeli designed missiles, including USA, which indicates that Israeli technology is extremely advanced.

9.2.5 Conclusions

1. Israel's survival has depended heavily on its military might and Israel has given high priority to self-reliance and assured security of supply in weapons. The country's arms industry is one of its strong military assets. The series of arms embargoes against Israel and the political pressure exerted by the arms supplier countries forced Israel to develop and maintain a capable defence industry.

2. Government involvement in the industry was important particularly in dealings and negotiations with USA. Military grants of approximately $1.8 billion annually from USA directly benefit Israeli industry for procurement, development and research programmes for aircraft, tanks, missiles and electronics systems.

3. Defence manufacturing technology was built up slowly starting with comparatively simple technology such as the design of tank turrets in 1954 to the manufacture of fighter aircraft in 1990. Israeli engineers learnt skills by working on licensed manufacturing and by working in defence companies in
foreign countries and bringing the skills back to Israel.

4. Other countries systems were manufactured under licence in Israel and designs were adjusted and improved to suit Israeli requirements. Israeli designed equipment has been sufficiently sophisticated that Israel has even arranged licence production of Israeli designed systems in USA, one of the world's most technically advanced countries.

5. Israel sought to support its domestic arms industry by exporting arms. Israel has a history of being a customer for arms with first-hand experience of the political pressure which can be exerted by the supplier nations' governments. Israel has strived to use the supply of arms technology to at least one customer country in order to apply political pressure to that country.
9.3. JAPAN

Japan, a constitutional monarchy with the emperor as a symbol of the state, is one of the world's major industrial powers and has the capability to manufacture nearly all of its military equipment (Forecast International, 1993). Japanese industry produces aircraft, ships, engines, military vehicles, small arms, missiles and electronic equipment. The security arrangement between USA and Japan, as described in the White Paper, 1995 by the Japanese Defense Agency, consisting of the 1954 Mutual Defence Assistance Agreement and the 1960 Treaty of Mutual Cooperation and Security, makes provision for equal military partnership within Japanese territory. As a result of the agreement, Japanese defence relied heavily on the USA for its defence structure including planning and equipment.

Japan promotes its image as a pacifist nation and under Article 9 of its constitution, the so-called "no war clause", the military priority is defence and not attack. In 1976 the Japanese cabinet stipulated that the military budget would not exceed 1% of the gross national product, GNP, but this stipulation was relinquished in 1986 and replaced by a similar stipulation in a five year development plan (Ikegama-Anderson, 1993). The result of this stipulation was that the arms industry had a steady and moderately expanding domestic market. The literature emphasises Japan's pacifist policies, economic success and its low level of military expenditure, but for completeness it is useful to examine the quantitative evidence of Japan's military stance. The pacifist country, Japan is sixth in the world ranking of highest military expenditure, with higher military expenditure for example than mainland China, Iraq.
(before the 1990 Gulf crisis), Saudi Arabia or Israel. Japan is the world's seventh leading arms importer, importing more than Iran, Germany, United Arab Emirates or Israel (SIPRI, 1993).

"The right of belligerency of the state will not be recognised" is the often quoted passage from the Japanese constitution of 1946 (SIPRI, 1971) and the constitution requires that Japan would use the minimum force necessary for defence. Nevertheless Japan's military capability has not been entirely limited by its constitutional intentions. The 1995 White Paper by the Japanese Defense Agency points out that diplomatic efforts alone are not always sufficient to prevent arms aggression from foreign nations and nor can they counter aggression if it takes place. The Paper concludes that military strength is the last resort in the defence of peace and security and defence capability had to be deliberately and continually built up. Cloughly (1996) points out that Japan has the capability of bringing major force to bear against an enemy. The air force is highly trained in both defence and strike techniques. The 1995 White Paper by the Japanese Defense Agency judges that there is strong possibility of any direct invasion starting with surprise aircraft and missile attack and that the aerial attacks would be repeated. The Paper points out that the Japanese defence forces would counter the attack by interception as far from Japanese territory as possible and at the same time by inflicting heavy damage on the enemy in order to make it difficult for the enemy to continue assaults. The Paper describes the importance of surveillance equipment (radars and airborne early warning) and interceptors (fighter aircraft and surface-to-air guided missiles) to counter aerial attack. The Japanese navy has sixteen conventional submarines which is the same
number as has the UK Royal Navy, and the army has a comparable number of tanks to the UK. Thus the Japanese defence industry does have a substantial domestic market despite the constraints of the constitution.

Ikegama-Anderson, 1993 has pointed out that Japanese industry has pursued arms development and production, not because it is particularly profitable but because the market is stable and secure and also the technology development is attractive. Ikegama-Anderson, 1993 reports that Japanese industry has deliberately directed effort to increase its share of the domestic market in competition with US suppliers. Government support to the defence industry is seen in willingness to fund development and procure domestically produced arms at far higher cost than procurement by import. The high level of research investment by industry has resulted in industry rather than government owning the technology. Japanese industrialists have formed powerful lobby groups which have proposed increased domestic share of defence procurement (Ikegama-Anderson, 1993) and the government five-year plan, Shin Chuki-Bofor for the period 1991 to 1995 included development plans specifically aimed at reducing the reliance of Japanese industry on US sources.

9.3.1 Military exports

Japan has no law which says that it cannot export weapon systems, but the Japanese companies wishing to export military products have to win approval from the Ministry of International Trade and Industry, MITI, which effectively disallows them (Ikegama-Anderson, 1993). The regulations forbidding arms exports have prevented
Japan from building up their arms industries to the same extent as other industries. Japanese companies have not been totally excluded from foreign defence markets. Cloughly, (1996) reported that Japan provided the former USSR with advanced marine propeller technology applicable to submarines. Japan has exported military radars and a range of dual use technologies including semiconductors and electronic components. Japan is the world's twentieth leading arms exporter, exporting more than Australia, Brazil, Italy or Argentina (US Arms Control and Disarmament Agency, 1992). The level of Japanese arms exports in 1989 was $110 million, which is very low in terms of the total Japanese exports, i.e. it represents less than 0.05% of total Japanese exports. For comparison the ratio of arms exports to total exports for the UK and for the USA is 2% and 3%. If Japan had a freer arms export policy and the ratio of arms to total exports were allowed to rise to the same level as other industrialised nations, then an estimate is that the level of arms exports might be forty to fifty times higher.

<table>
<thead>
<tr>
<th>Table 9.3.1 Value in Millions US Dollars of Arms Exports in 1989.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
</tr>
<tr>
<td>Arms exports</td>
</tr>
<tr>
<td>Arms exports/total exports</td>
</tr>
</tbody>
</table>


Ikegama-Anderson (1993) considers that a share of Japanese exports is in dual use technology such as semiconductors and aircraft materials to be used on weapon systems and in aircraft manufacture in overseas companies and therefore there is
indirect involvement of Japanese industry in international arms production.

9.3.2 The Japanese Defence Industry

Japan shares common economic interests with the USA as both are major economic powers of the world (Cloughly, 1996) and Japan is one of the USA's biggest military customers (US Arms Control and Disarmament Agency, 1992). The Japanese defence industry was dismantled or requisitioned by the Allied Forces after Japan's defeat in World War II and renewal of the defence industry began after the outbreak of the Korean war, 1950 to 1953 (Ikegama-Anderson, 1993). At that time Japan was virtually totally dependent on the USA for the supply of defence equipment. The United States was instrumental in starting military production in Japan through its arms procurement plan for the American forces in Korea and through US special procurement programmes for South East Asia. The development of the aircraft, missile and arms industries in Japan has been based on technology transfer from USA and licensed production of US systems. The Japanese Defence Agency figures reported in Defence News (3 December 1990) indicated that by 1990 Japanese industry was producing 40% of the weapon requirements either indigenously or through licensed production and 60% was imported from the USA, and the Office of Technology Assessment (1991) reported that Japanese industry was producing 90% of Japanese defence equipment.

Ikegama-Anderson, 1993 noted that the Japanese Government has promoted international cooperation in research and development in defence technologies in order to raise the skills available in-country. From the end of World War II there was
a flow of technology from the USA to Japan and the Japanese technology base grew. In the 1980s there were agreements between the USA and Japan to redress the imbalance in the flow of military technology and to enable Japanese technology to be transferred to the USA. Actions were taken to create a "two way street" and to set up a framework for collaboration on military technologies:

- Exchange of Technology Agreements, 1983
- Detailed Arrangements for the transfer of Military Technologies, 1985
- A government to government agreement in 1987 involving Japanese participation in the USA Strategic Defence Initiative, SDI, research project.

In March 1990 America and Japan agreed to co-operate on research and development of technologies which were considered critical to three areas of future US military systems: submarine stealth, target seeker technology for missiles and high efficiency rocket engines. The view expressed by the Office of Technology Assessment (1991) was that technical cooperation had resulted in major benefit to Japan in the build up of Japanese military technology and a strong defence industrial base but there had been a failure to produce a reciprocal flow of technology to the USA.

### 9.3.3 The Japanese Aircraft Industry

The Congress of the United States Office of Technology Assessment (1991) considered that licensed production of several types of USA military aircraft has made a major contribution to the development of aerospace technology in Japanese companies and examples of licensed production programmes include:
Bell UH-1H Huey helicopter
Bell AH-1S Cobra helicopter
Lockheed P-3C Orion patrol aircraft
Boeing 107 Model II helicopter
Boeing CH-47 Chinook helicopter
McDonnel Douglas Model 500D helicopter
McDonnel Douglas F-4E Phantom jet fighter aircraft
McDonnel Douglas F-15J and F-15DJ Eagle jet fighter aircraft
Sikorsky S-61, S-61A and S-61B helicopters.

The Japanese FS-X programme, the Fighter Support Exploratory aircraft, was aimed at Mitsubishi developing an improved version of the USA F-16C fighter aircraft, and to replace the F-1 aircraft in the Japanese inventory. The programme was being negotiated in 1990 as a codevelopment programme involving technology sharing with the US company General Dynamics, which later became Lockheed Martin, and cost sharing was set at 60% Japan and 40% USA. There was concern in both countries about the possible loss of technology lead and the level of technology transfer and the result was that by 1995 Japan was totally responsible for the FS-X programme including the funding (Jane's All the World's Aircraft, 1994-5).

9.3.4 The Japanese Missile Industry

Japan is a major missile manufacturer, most of the missile systems being manufactured by Mitsubishi Heavy Industries, Mitsubishi Electric Corporation, Tokyo Shibaura Electric which is part of Toshiba and Kawasaki Heavy Industries (Kiernan
Chaisson, 1995). Mitsubishi Heavy Industries which is the largest Japanese missile producer was in 1995 continuing attempts to reduce and eventually eliminate its dependence on USA designed missiles and had undertaken a range of missile development projects. Toshiba specialises in surface to air missiles and provides a smaller share of the missile market than Mitsubishi.
Table 9.3.4  Japanese missiles in development, production or use in 1995.

<table>
<thead>
<tr>
<th>MISSILE DESIGNATION</th>
<th>MANUFACTURER</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAM-1 air-to-air</td>
<td>Mitsubishi Heavy Industries</td>
<td>Reported to be based on the design of the USA Sidewinder missile.</td>
</tr>
<tr>
<td>AAM-2 air-to-air</td>
<td>Mitsubishi Heavy Industries</td>
<td></td>
</tr>
<tr>
<td>AAM-3 air-to-air</td>
<td>Mitsubishi Heavy Industries</td>
<td>This is an indigenous replacement for the imported AIM-9 Sidewinder missile in the Japanese inventory.</td>
</tr>
<tr>
<td>AAM-4 air-to air</td>
<td>Mitsubishi Heavy Industries</td>
<td>This is reported to be similar to the AIM-Sparrow missile which was both imported into Japan and produced in Japan under licence.</td>
</tr>
<tr>
<td>AAM-5 air-to-air</td>
<td>Mitsubishi Heavy Industries</td>
<td></td>
</tr>
<tr>
<td>AIM-7E SPARROW air-to-air</td>
<td>Raytheon USA/General Dynamics USA but co-produced by Mitsubishi Japan.</td>
<td>Production in Japan under licence from USA</td>
</tr>
<tr>
<td>AIM-7F SPARROW air-to-air</td>
<td>Raytheon USA/General Dynamics USA but number manufactured by Mitsubishi Japan.</td>
<td>Production in Japan under licence from USA</td>
</tr>
<tr>
<td>AIM-7N SPARRÔW air-to-air</td>
<td>Raytheon USA/General Dynamics USA but number manufactured by Mitsubishi Japan.</td>
<td>Production in Japan under licence from USA</td>
</tr>
<tr>
<td>TYPE 64 anti-tank ML</td>
<td>Kawasaki Heavy Industries</td>
<td></td>
</tr>
<tr>
<td>TYPE 64 anti-tank MA</td>
<td>Kawasaki Heavy Industries</td>
<td></td>
</tr>
<tr>
<td>TYPE 79 anti-tank</td>
<td>Kawasaki Heavy Industries</td>
<td>The Kawasaki Type 79 is reported to be very similar in configuration and in operation to the USA Hughes anti-tank TOW missile which Japan has purchased from USA.</td>
</tr>
<tr>
<td>TYPE 80 ASN-1 anti-ship</td>
<td>Mitsubishi Heavy Industries</td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>Sub-Type</td>
<td>Supplier</td>
</tr>
<tr>
<td>------------------</td>
<td>---------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>TYPE 81</td>
<td>surface to air</td>
<td>Tokyo Shibaura Electric</td>
</tr>
<tr>
<td>TYPE 87</td>
<td>wti-tank</td>
<td>Kawasaki Heavy Industries</td>
</tr>
<tr>
<td>TYPE 90</td>
<td>SSN-1B</td>
<td>Mitsubishi Heavy Industries</td>
</tr>
<tr>
<td>TYPE 90SSN-1B</td>
<td>anti-ship</td>
<td>Mitsubishi Heavy Industries</td>
</tr>
<tr>
<td>TYPE 91 KEIHO</td>
<td>surface to air missile</td>
<td>Tokyo Shibaura Electric</td>
</tr>
<tr>
<td>Type 93</td>
<td>ASN-2 anti-ship missile</td>
<td>Mitsubishi Heavy Industries</td>
</tr>
<tr>
<td>MIM-104</td>
<td>Patriot</td>
<td>Raytheon USA and Martin Marrietta</td>
</tr>
<tr>
<td>MIM-23 HAWK</td>
<td>surface to air missile</td>
<td>Raytheon USA</td>
</tr>
<tr>
<td>BGM-71D TOW2</td>
<td>anti-tank missile</td>
<td>Hughes Aircraft Company</td>
</tr>
</tbody>
</table>


Analysis of the Japanese missile systems listed in Table 9.3.5 above shows that one third are licensed designs and two thirds are indigenously designed and produced. Japan's largest requirement for missiles is for the anti-ship role, and these are indigenously manufactured in Japan. Approximately one fifth by value of the world's anti-ship missiles are manufactured by Mitsubishi, and the company is second only to the Russian Federation Arsenal in the level of anti-ship missile manufacturing.
9.3.5 Japanese Tank Industry

The main purpose of tanks is to spearhead an attack into a battle zone to take the land quickly and allow the troops to follow up and secure the position (Foss, 1987). The Japanese constitution, Article 9, the "no war clause" dictates that the military priority is defence rather than attack and therefore the Japanese requirement for tanks in Japan has not been as great as the requirement for sea or air defence systems. The Japanese tank industry therefore has a smaller domestic market in comparison to the ship and aircraft industries. Examination of Table 9.3.5.1 shows that the tanks in use in the Japanese inventory were American in 1950, one American and two Japanese (with a high level of US and German features) in 1986 and all Japanese manufactured with no imported tanks in 1993.
### Table 9.3.5.1 Japanese tanks in deployment with the Japanese Ground Self Defence Force

<table>
<thead>
<tr>
<th>Year</th>
<th>Tank designation</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>Sherman M4 Medium Tank. Manufactured in USA, American Locomotive Company, Baldwin Locomotive Works, Detroit Tank Arsenal, Ford Motor Company, etc.</td>
<td>Imported</td>
</tr>
<tr>
<td></td>
<td>M24 Chaffee manufactured in USA.</td>
<td></td>
</tr>
<tr>
<td>1986</td>
<td>M41 manufactured by General Motors Corporation, USA</td>
<td>Imported</td>
</tr>
<tr>
<td></td>
<td>Type 61 manufactured by Mitsubishi, Japan.</td>
<td>Japanese manufacture. Similarity in design of turret to the USA M4 Sherman tank.</td>
</tr>
<tr>
<td></td>
<td>Type 74 manufactured by Mitsubishi, Japan.</td>
<td>Japanese manufacture. Contains many features of German, USA, British and French tanks.</td>
</tr>
<tr>
<td>1993</td>
<td>Type 90 manufactured by Mitsubishi, Japan.</td>
<td>Indigenous manufacture in Japan except for the 120mm smooth bore gun which is being manufactured under licence from Rheinmetall of Germany.</td>
</tr>
<tr>
<td></td>
<td>Type 61 manufactured by Mitsubishi, Japan.</td>
<td>Japanese manufacture.</td>
</tr>
<tr>
<td></td>
<td>Type 74 manufactured by Mitsubishi, Japan.</td>
<td>Japanese manufacture.</td>
</tr>
</tbody>
</table>


The Japanese Ground Self Defence Force was formed in 1950 (Ikegama-Anderson, 1993) and the USA supplied the Force with Sherman and M24 Chaffee tanks. The USA also supplied M47 tanks for evaluation. The American tanks were not designed for the small height of the Japanese soldiers and the size and weight of the tanks...
were not optimised for transportation over Japanese mountainous territory (Ikegama-Anderson, 1993). The General Motors light tank, the M41, which was developed after the M24, was exported to Japan and was the only imported tank of the three battle tanks in the Japanese tank inventory in 1986 (Jane's Armour and Artillery 1986-87).

In 1954 the Technical Research and Development Headquarters of the Japanese Self Defence Force began the design of the first post war Japanese tank. Four prototypes were produced, the ST-A3 and ST-A4 and in 1962 a standard Type 61 Main Battle Tank was produced by Mitsubishi Heavy Industries. There is similarity to the USA M4 which the Japanese had in inventory, in the overhanging design of the turret of the Japanese Type 61 (Jane's Armour and Artillery 1986-87 and 1994-95). The Type 61 is one of the three types of main battle tanks in deployment by the Japanese forces in 1993 (Table 9.3.5.1).

In 1962 the Japanese Ground Self Defence Force and Mitsubishi began to define the requirements of a new tank which was to become the Type 74 Main Battle tank (Jane's Armour and Artillery 1986-87 and 1994-95). The design contained the features of many other state of the art tanks being developed by other countries at that time:

- hydro-pneumatic suspension of the MVT-60 tank.
- hull of the German Leopard tank.
- 105mm gun as used on the German Leopard, the USA A-60, British Centurion and other tanks.
The Type 74 Main Battle Tank was one of the three main battle tanks deployed by the Japanese forces in 1993 (Table 9.3.5.1).

In 1976 Japan started the research and development plan for a new tank, the STC, TK-X (Jane's Armour and Artillery 1986-87 and 1994-95). The first two prototypes had Japanese 120mm guns but it became necessary to replace them with the German Rheinmetall 120mm small bore gun. By 1987 the prototype design was complete. The tank was designated the Type 90 and it is indigenously manufactured in Japan except for the 120mm smooth bore gun which is being manufactured under licence from Rheinmetall of Germany. The turret is very similar to the turret of the German Leopard 2 tank.

The developments of Japanese tanks since the 1950s to the 1990s described in this section and summarised in Table 9.3.5.1 have shown that the Japanese tank industry has benefitted from the designs of US imported tanks and from the influence of European designs. More complex elements of the tank such as the suspension, the hull design, the turret, the gun were imported, copied or manufactured under licence in the 1960s. By the 1990s the new Japanese main battle tank is indigenously designed except for the licence produced gun.

Table 9.3.5.2 shows the 1993 tank inventories of the major tank producing countries:
Table 9.3.5.2 Tank inventories in the year 1993 of the armed forces of major tank producing countries.

<table>
<thead>
<tr>
<th>Country</th>
<th>Tank inventory in 1993</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commonwealth of Independent States</td>
<td>37,000</td>
</tr>
<tr>
<td>USA</td>
<td>19,806</td>
</tr>
<tr>
<td>France</td>
<td>1,470</td>
</tr>
<tr>
<td>Germany</td>
<td>4,070</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>1,198</td>
</tr>
<tr>
<td>Japan</td>
<td>1,215</td>
</tr>
</tbody>
</table>

Source: table by current author from data in World's Defence Almanac 1993

The tank inventory, i.e. the domestic market of the Japanese tank industry, is an order of magnitude less than that of USA or CIS and is comparable to the inventory of France, UK and Germany. The Japanese tank manufacturers do not have access to export markets as do the manufacturers of other countries. The procurement of the indigenous Type 90 Main Battle Tank was reported to have cost 1.2 billion yen, which is three times as much as the USA equivalent, the M1A1 Abrams tank (Ikegama-Anderson, 1993).

9.3.6 Japanese Shipping

The navy has been an important part of the Japanese defence force because the main perceived threat to the nation was the former Soviet Union and Japan stands between the Russian Pacific fleet bases at Vladivostock and Sovyetkaya Cavan and the Pacific Ocean (Forecast International, 1991). The Japanese naval fleet is the third largest in
the world after America and Russia when measured in terms of the numbers and age of escort craft and conventional submarines (World’s Defence Almanac 1993).

The principle manufacturers of naval ships (Jane’s International Defence Directory, 1993) are:

- Mitsubishi Heavy Industries: submarines, destroyers
- Kawasaki Heavy Industries: submarines, gas turbine engines licensed by Rolls Royce,
- Ishikawajima Heavy Industries: destroyers, amphibious craft
- Sumitomo: destroyers, frigates
- Mitsui: destroyers, frigates
- Hitachi: destroyers, frigates

There are less reports of technology transfers or licensed production of ships than for airborne or land based weapon systems (SIPRI, 1993) but unattributable comments by naval experts indicate that the indigenous Japanese designs closely resemble US ships.

9.3.7 Conclusion

1. After World War II the Japanese defence industry was dismantled. Renewal of the defence industry began in the early 1950s after the outbreak of the Korean War mainly through the setting up of USA special procurement
programmes based on technology transfer and licensed production of US systems. Japan seized the opportunity to use licensed manufacturing as a mechanism to upgrade the skill of its workforce. Licensed production of US designed equipment has been key to enabling Japan to re-establish its arms industry. As the Japanese defence industry became established industrial and Government policy was directed to reducing dependence on USA sourced technology. The level of self sufficiency of arms rose from 0% in 1950 to between 40% and 96% in the 1990s.

2 Japan has a highly diversified industrial base and is one of the world's major industrial powers. The country is sixth in the world ranking of highest military expenditure and therefore the domestic market for Japanese defence industry is substantial in world terms.

3. The limited access to arms exports and Japan's pacifist policies indicate that the potential for earning foreign exchange and gaining influence on customer nations is not an important issue in the strategy to build and retain a defence industry.

4. The USA has expressed concern over the transfer of technology to Japan and the loss of technology lead. This was demonstrated in the negotiations of the joint development of the Japanese FS-X aircraft in the early 1990s and resulted in Japan taking full responsibility for the programme which demonstrated Japan's requirement for improved self-reliance and security of
supply.

5. The extra cost of indigenous production over the cost of imported arms demonstrates that short term cost reduction is not as important as other issues relating to the promotion of a domestic arms manufacturing capability.
The Association of South-East Asian Nations, ASEAN, was formed by Indonesia, Malaysia, the Philippines, Singapore and Thailand in August 1967 (Europa World Yearbook, 1991). The group was joined in 1984 by Brunei and by Vietnam in 1995. In the early 1990s discussions were progressing on Laos, Cambodia and Myanmar joining the association but this had not been achieved by 1996 (Barclays Economics Department Country Report, 1996). There has been a steady build up of defence capabilities in all the countries of south-east Asia in the decade since the setting up of the association except for Vietnam and Thailand (SIPRI Yearbooks 1991, 1995). South East Asia's defence expenditure has risen as a proportion of world defence expenditure from 15% in 1980 to 25% in 1991.

The ASEAN countries have recognised that regional stability is highly dependant on the balance of military power and it was not until the 1990s that the Association started to address military issues (Cloughly, 1995). ASEAN was set up primarily for economic development and cooperation and not for military alliance. The ASEAN countries do not welcome interference from fellow members on their own domestic disputes and do not have multi-lateral co-ordination on military issues (Willett, 1996). The individual countries do have bilateral links, for example the Malaysian purchase of equipment from Indonesia. The ASEAN forces co-operated for the first time in 1993 in a military exercise hosted by Australia, the forces comprising the navies of Malaysia, Singapore and Thailand, Singapore Air Force and observers from Thailand (Cloughly, 1995). Also in 1993 security and defence were discussed between the
member countries for the first time under the auspices of the newly created ASEAN Regional Forum. The discussions included regional security issues and economic cooperation but did not extend to any multilateral defence arrangement or co-ordination of equipment procurement (Jane's Defence Weekly, 8 May 1993 and 18 December 1993). In June 1996 the ASEAN Regional Forum issued a communique challenging China's claim to sovereignty in the South China Sea (Defence News, 29 July 1996). The significance of this event is that it was the first serious security issue addressed by the alliance.

Table 9.4 presents a summary of the arms production and military profiles of the ASEAN countries: the table shows the wide variations in the economics and the military profiles between the countries.
### Table 9.4 The arms production and military profile of the ASEAN countries

<table>
<thead>
<tr>
<th></th>
<th>Brunei</th>
<th>Indonesia</th>
<th>Malaysia</th>
<th>Philippines</th>
<th>Singapore</th>
<th>Thailand</th>
<th>Vietnam</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GNP</strong></td>
<td>$3,500 million</td>
<td>$12,000 million</td>
<td>$48,000 million</td>
<td>$47,000 million</td>
<td>$34,600 million</td>
<td>$92,600 million</td>
<td>$15,000 million</td>
</tr>
<tr>
<td>Million US Dollars, in 1991</td>
<td>$8,600 per capita</td>
<td>$630 per capita</td>
<td>$2,670 per capita</td>
<td>$720 per capita</td>
<td>$1,700 per capita</td>
<td>$1,630 per capita</td>
<td>$220 per capita</td>
</tr>
<tr>
<td><strong>Growth rate</strong></td>
<td>1%</td>
<td>6%</td>
<td>5%</td>
<td>7% (in 1991)</td>
<td>9% (in 1991)</td>
<td>8% (in 1990)</td>
<td>4%</td>
</tr>
<tr>
<td><strong>MILITARY EXPENDITURE</strong></td>
<td>$233.1 million</td>
<td>$1,700 million not including arm acquisition</td>
<td>$2,400 million</td>
<td>$915 million</td>
<td>$2,462 million (1992/93)</td>
<td>$2,700 million (1992/93)</td>
<td>$1,400 million (Estimated 1989)</td>
</tr>
<tr>
<td>7% of GDP</td>
<td>5% of GDP</td>
<td>1.9% of GDP</td>
<td>5% of GDP</td>
<td>7% of GDP</td>
<td>2.9% of GDP</td>
<td>3.1% of GDP</td>
<td>5.2%</td>
</tr>
<tr>
<td><strong>NUMBER ARMED FORCES</strong></td>
<td>4,400</td>
<td>285,000</td>
<td>121,300</td>
<td>154,540</td>
<td>5,500</td>
<td>260,000</td>
<td>1,260,000</td>
</tr>
<tr>
<td><strong>DEFENCE IMPORTS p.a.</strong></td>
<td>$154 million p.a.</td>
<td>$154 million p.a.</td>
<td>$50 million p.a.</td>
<td>$221 million p.a.</td>
<td>$289 million p.a.</td>
<td>$1846 million p.a. (97% imported from the Soviet Union, 3% from other Warsaw Pact countries)</td>
<td></td>
</tr>
<tr>
<td><strong>AVERAGE OVER 5 YEARS, 1985 to 89</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DEFENCE EXPORTS</strong></td>
<td>$4.2 million p.a. over 5 yrs</td>
<td>$4.4 million p.a. over 5 yrs</td>
<td>$5.5 million p.a. over 5 yrs</td>
<td>$7 million p.a. in 1989</td>
<td>$0 million p.a. over 5 yrs</td>
<td>$45 million p.a. over 5 yrs</td>
<td></td>
</tr>
<tr>
<td><strong>USA OFFSET</strong></td>
<td>Offset obligation $22.6 million</td>
<td>none</td>
<td>$25.3 million offset obligation</td>
<td>$153.1 million offset obligation</td>
<td>$0 million in 1989</td>
<td>$0 million in 1989</td>
<td>$0 million in 1989</td>
</tr>
<tr>
<td><strong>OBLIGATIONS ON ARMS DEALS 1990 to 1997</strong></td>
<td>(10% on contracts valued $119.2 million)</td>
<td></td>
<td>(35.1% on contracts valued $55.1 million)</td>
<td>(29.5% on contracts valued $551.5 million)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ARMS PRODUCTION</strong></td>
<td>None, Aircraft industry, strong manufacture under licence capability</td>
<td>Aircraft industry, strong manufacture under licence capability</td>
<td>Defence industry is in its infancy. Aircraft repair and overhaul facilities becoming established.</td>
<td>Government policy for technology transfer, industrial offsets on arms deals</td>
<td>There is very low domestic requirement to sustain a defence industry.</td>
<td>Largest defence industry in ASEAN group. Mainly in component manufacture, overhaul, assembly in aircraft industry.</td>
<td>Very low level arms production.</td>
</tr>
<tr>
<td></td>
<td>Ship building reflects high level of inter-island trade.</td>
<td>Ship building reflects high level of inter-island trade.</td>
<td>Government policy that arms industry manufactures 25% arms and 57.5% civil products.</td>
<td>Government policy for countertrade/technology transfer on arms import deals</td>
<td>There is low level of licensed production.</td>
<td>Country has a substantial military equipment budget.</td>
<td>Almost self-sufficient in small arms, artillery, ammunition.</td>
</tr>
<tr>
<td></td>
<td>Government policy that arms industry manufactures 25% arms and 57.75% civil products.</td>
<td>Government policy for countertrade/technology transfer on arms import deals</td>
<td></td>
<td></td>
<td>Aircraft industry carries out licensed production and maintenance.</td>
<td>The government took steps to provide incentives and investment in aerospace, and in research and development</td>
<td>Low level production aircraft components</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Licensed production in shipbuilding.</td>
</tr>
</tbody>
</table>

9.4.1 Brunei

Brunei is the second richest ASEAN country, after Singapore, in terms of GNP per capita and has the smallest population (Europa World Yearbook, 1991). Brunei was a British Protected State until 1971 when it was granted full self government. Britain remained responsible for advice on defence matters until independence in 1984 but continued to have strong links with Brunei in military training and arms sales and in the presence of the British Gurkha battalion in Brunei (Cloughly, 1995). Brunei has military links with another ASEAN country in that Singapore has an infantry battalion based in Brunei. Brunei armed forces also have military training in Australia and in USA.

The flourishing economy of this oil rich country depends almost entirely on income from rents, royalties, taxes and dividends from the oil and gas industries (Europa World Yearbook, 1991). The need to diversify economically was recognised in a series of government development plans and in the fifth development plan covering 1986 to 1990 plans were announced to set up a regional centre for finance and banking. Brunei has neither the requirement nor the capability to manufacture arms (Cloughly, 1995). Brunei has a high level of education but lacks technology and marketing expertise to diversify industrially. Brunei has no arms manufacturing companies, no defence research organisations and no military service companies (Jane's International Defence Directory, 1995). The size of the armed forces is very small at 4,400 personnel in 1991 (Bonsignore, 1993) and the requirement for arms is negligible. Effort has been directed to a higher priority of becoming more self-sufficient in food production (Europa World Yearbook, 1991).
9.4.2 Indonesia

Indonesia is the largest of the ASEAN countries with 13,677 islands, the largest being Sumatra (Europa World Yearbook, 1991). It has an oil-dependent economy and is a member of the Organisation of Petroleum Exporting Countries, OPEC. There are vast natural resources and Indonesia exports tin, gas, coffee, wood and rubber. A military priority is given to monitoring, controlling and safeguarding the waters and the islands' natural resources (Cloughly, 1995).

Indonesia has experienced a history of arms blockades and political pressure from its supplier countries (SIPRI, 1971). Its traditional supplier, the USA, restricted arms supplies to the Indonesian armed forces and supplied arms to insurgents in 1958 and consequently Indonesia turned to other supplier countries, mainly Warsaw Pact countries. Again in 1960 the USA refused to make additional arms available and Indonesia obtained arms from the Soviet Union. When Great Britain embargoed arms exports to Indonesia in 1962 further supplies were obtained from the Soviet Union. In 1963 anti-British riots broke out in response to the establishment of the Federation of Malaysia, an event seen in Indonesia as perpetrating British imperialism. A number of British owned companies in Indonesia was seized and an arms embargo against Indonesia was enforced by Great Britain, USA and Canada.
9.4.2.1 Arms production in Indonesia

Indonesia's goal is to achieve a degree of self sufficiency in arms production and aims to achieve a self-sustaining, dual use, defence/civil industry without government subsidy (Matthews, 1993). After Singapore, Indonesia has the second most diversified and advanced defence industrial base in the ASEAN group (Congress of the United States, Office of Technology Assessment). Countertrade is widely used to provide technology transfer to Indonesian civil and military industry and to secure offset manufacturing contracts (Congress of the United States, Office of Technology Assessment, 1991). In the early 1990s the country continued to import the majority of its defence equipment and the value of indigenous production, mainly production of aircraft, remained steady but low (Matthews, 1993).

9.4.2.2 The dual function "Dwi Fungsi" defence industry

Indonesia's approach to increasing self-sufficiency in arms differs from that of other industrialised countries in that the government policies are directed towards a defence industry which in peacetime allocates three quarters of its production capacity to civil production and one quarter to military production but which retains the capability to ramp up to surge production at a time of crisis (Matthews, 1993). By 1990 the defence industry continued to be subsidised by the government, but there were plans to remove industrial subsidies. The Minister of State for Research and Technology, Dr B.J.Habibie, laid out the plans for the integration of the country's civil-military-industrial development (Matthews, 1993) and the emphasis was on the promotion of efficiency through local technology development (Willett, 1996). The aim was to achieve a network of skilled subcontractors, funded partly by compulsory
contributions from the prime contractors' profits. The shipbuilding and aerospace industries were considered as the technological leaders of the civil-military industrialisation programs. Culturally, Indonesia's military role is merged with its civil activities. In February 1988 the dual function, or Dwi Fungsi, i.e. the military and socio-economic function of the Indonesian Armed Forces, the ABRI, was codified under new legislation. The armed forces and the civilians share defence responsibility and civilians are expected to wage guerrilla warfare in support of ABRI (Willett. 1996).

9.4.2.3 Aircraft industry in Indonesia

The main focus of Indonesia's defence industry has been the aircraft industry for the manufacture and assembly of transporter aircraft, trainers and helicopters mainly under licence (Congress of the United States, Office of Technology Assessment, 1991). Table 9.4.2.3 shows the licensed military production activities in Indonesia from 1972 to 1992.

<table>
<thead>
<tr>
<th>Date</th>
<th>Weapon system</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1976</td>
<td>CN-212 Aviocar transport aircraft from Spain.</td>
<td>40</td>
</tr>
<tr>
<td>1982</td>
<td>Model 412 helicopter from USA.</td>
<td>16</td>
</tr>
<tr>
<td>1982</td>
<td>PB-57 Patrol craft from Germany F.R.</td>
<td>6</td>
</tr>
<tr>
<td>1983</td>
<td>AS-332 Super Puma helicopter from France.</td>
<td>10</td>
</tr>
<tr>
<td>1987</td>
<td>NBo-105 helicopter from Germany F.R.</td>
<td>60</td>
</tr>
<tr>
<td>1992</td>
<td>Hawk-100 trainer aircraft from UK.</td>
<td>14</td>
</tr>
<tr>
<td>1992</td>
<td>Hawk-200 trainer aircraft from UK.</td>
<td>10</td>
</tr>
</tbody>
</table>

Source: table by current author from data presented by SIPRI (1993)
The Indonesian government centralised the aerospace facilities to form the company Industri Pesawat Terbang Nusantara, IPTN, in 1976 (Congress of the United States, Office of Technology Assessment, 1991). In 1980 the Aircraft Technology Industries consortium of IPTN of Indonesia and CASA of Spain started the design and coproduction of the CN-235 multi-purpose transport aircraft. Design and production were shared equally. By 1995 215 of these aircraft had been ordered and 124 had been delivered in civil and military versions to eighteen countries such as France, Spain, Turkey, Saudi Arabia, South Korea and the ASEAN countries Brunei, Indonesia and Malaysia (Jane's All the World's Aircraft, 1995). The supply of Indonesian built CN-235 transporters to Malaysia involved a countertrade of Malaysian built Proton cars, and CN-235 transporters to Thailand involved a countertrade of rice (Willett, 1996). In 1989 Indonesia announced its first indigenously designed transport aircraft, the IPTN N-250-100, and the first flight of this aircraft was in 1995. Indonesia was seeking an agreement with USA to set up a second production line for the N-250-100 in the USA (Jane's All the World's Aircraft, 1995). The IPTN company has a division for the production of weaponry for aircraft. The company also produces components for the USA Boeing 737 and 767, the German Fokker 100 and the USA Lockheed F-16, and carries out maintenance, overhaul and repair for a wide range of aircraft engines (Congress of the United States, Office of Technology Assessment, 1991).
9.4.2.4 Ship building

Ninety per cent by value of Indonesia's trade is by sea and the country's ship building industry supports inter-island trade (Congress of the United States, Office of Technology Assessment, 1991). The company PT PAL specialises in the build and repair of civil and military ships. Indonesia has the capability to build patrol craft, for example in the 1950s and 1960s twenty seven patrol craft and two submarine chasers were built (SIPRI, 1971). Indonesia continues to rely heavily on the import of naval vessels, for example in the acquisition of 39 former East German ships in 1992 (SIPRI, 1993). In 1995 a total of six naval ships were under construction for Indonesia, four being built domestically and two imported (Jane's Fighting Ships Special Report, 1995).

9.4.2.5 Ordnance

The company PT Pindad produces small arms and ammunition. The company's manufacture of civil products including electric generators, traction motors and airbrakes for the railway industry was in 1993 not running at full capacity and only the military product lines contributed to company profits (Congress of the United States, Office of Technology Assessment, 1991).

9.4.2.6 Countertrade

Indonesia has a strict countertrade policy in order to fill its production capacity and to benefit from technology transfer (Matthews, 1993). Table 9.4.2.3 shows the licensed production agreements of aircraft and ships. Offset agreements are often a feature of foreign purchases (Congress of the United States, Office of Technology Assessment, 1991).
Assessment, 1991). An offset deal concerning the purchase of F-16 fighter aircraft in the late 1980s committed General Dynamics to the procurement of components for F-16s (Willett, 1996). In the early 1990s the shipbuilders PT PAL negotiated collaborative agreements with the German company MAN, the Japanese company Mitsubishi and the Finnish Wartsilla for repair and maintenance contracts: PT Pindad, the ordnance company had negotiated collaborative production of machine tools with Japanese, Dutch, German and Taiwanese companies (Willett, 1996).

9.4.3 Malaysia

In the 1990s Malaysia has had one of the fastest growing economies in South East Asia and has emerged from being a developing to a newly industrialised country (Karniol, 1995). Malaysia's exports were highly dependent on rubber and tin but the export list has diversified to palm oil, timber, petroleum, gas, cocoa and manufactured goods. The defence budget dropped from 6% of GDP to 2.3% of GDP from 1985 to 1988.

Since the Communist Party of Malaya launched an insurgency in 1948 the Malaysian Armed Forces were structured to concentrate on internal security (Europa World Yearbook, 1991). In 1989 the outlawed Communist Party agreed to a negotiated settlement with the government and following this agreement the government decided to change the nature of the armed forces from counterinsurgency to a conventional force (Karniol, 1995). Equipment procurement in the first half of the 1990s was aimed at developing conventional force capability.
Malaysia and Brunei are the few ASEAN countries which do not produce major weapons. Military production is limited to shipbuilding, small arms and ammunition and electrical equipment manufacture (Forecast International, 1993). Malaysia's economic 5-year development plans include developing the armed forces capabilities and there have been efforts to link defence and economic development in the 6th Malaysian Plan of 1991-1995 (Karniol, 1995). The Malaysian Defence Minister Dat' Syed Hamid Albar emphasised that military procurement should be linked to industrial offset programmes. Examples of industry development plans to be linked with arms purchase were a) procurement of offshore patrol ships was linked to extending the capabilities of the Lumut shipyard from overhaul and maintenance to full shipbuilding (Willett, 1996), b) in 1994 a contract for 20 Russian Mikoyan MiG-29 fighter aircraft included payment with refined palm oil worth $95 million and c) as part of the 1994 Memorandum of Understanding with Korea the procurement of Daiwoo Infantry Fighting Vehicles was linked to an agreement by Daiwoo Heavy Industries to set up assembly plants in Malaysia for fork lift trucks and land excavating vehicles.

In 1995 two naval warships were under construction for Malaysia, both foreign built by Yarrow Shipyards of Glasgow and none were being built domestically (Jane's Fighting Ships Special Report, 1995).

Malaysia has had success in developing refurbishment and repair facilities for aircraft including facilities for the Hercules C-130 transporter aircraft. Airod Sdn Bhd, based in Selangor, is a joint venture company formed by the USA company Lockheed
Aircraft Services and the Aerospace Industries Malaysia Sdn Bhd for the maintenance, repair and overhaul of both civil and military aircraft and the manufacture of components and electronics (Jane's All the World's Aircraft, 1995). Another joint venture company Dornier Seastar Malaysia SDn Bhd was formed in 1993 by the German company Dornier and three Malaysian companies, Aerospace Industries Malaysia, Realmild and Koperasi Polis. The DSM company agreed to establish a manufacturing facility scheduled to start production of Dornier Seastar CD 2 seaplanes in 1996 (Jane's All the World's Aircraft, 1995).

9.4.4 Singapore

Singapore possesses the largest defence industry in the ASEAN group (Congress of the United States, Office of Technology Assessment, 1991). The country has had rapid growth in civilian manufacturing in the 1960s, 70s and 80s (Europa World Yearbook, 1991) and the advanced industrial infrastructure supports a wide range of production capabilities and services, partly due to international corporations from USA, Europe and Japan setting up trading and manufacturing facilities in Singapore (Congress of the United States, Office of Technology Assessment, 1991).

Shanson (1990) described how Singapore's military strategy and structure were modeled with the help of Israeli advisers and there is a degree of similarity in that both countries have achieved a substantial level of domestic arms production. Singapore has made military links with foreign defence forces. Military training is carried out with USA, Taiwan, Indonesia and Brunei. Training on the F-16 fighter aircraft is carried out in USA and other flying training in Australia (Cloughly, 1995).
Chapter 9

The USA regional naval logistics command headquarters which was withdrawn from the Philippines is based in Singapore.

There has been high level of government involvement in the development of the defence industry. The Singapore Government promoted ship building in the late 1960s and provided substantial investment in shipyards, the Singapore Shipbuilding and Engineering Pte, Sembawang Shipyard and Keppel Shipyard Pte (Congress of the United States, Office of Technology Assessment, 1991). Japanese shipping companies began using Singapore as an export base. The government attracted foreign investment in the aerospace industry. Foreign companies were given financial and tax incentives to set up manufacture and repair facilities in Singapore. There were ten-year tax breaks from the usual 33% corporate income tax (Congress of the United States, Office of Technology Assessment, 1991). Aircraft component manufacture, assembly and overhaul facilities were set up by Pratt and Whitney, Hawker Pacific, TRW, General Electric, Sundstrand, Garrett and Westinghouse. Companies were attracted by the skilled workforce and low wage rates. The output from the Singapore aerospace sector grew dramatically ($47million in 1977 to $795million in 1987). Many foreign airlines use Singapore as a repair and overhaul base. During the 1970s there was substantial foreign investment in electronics, metal working and precision instrumentation (Europa World Yearbook, 1991) and multinational companies such as Hewlett-Packard, National Semiconductor, SCM and Cincinnati Milacron located facilities in Singapore (Congress of the United States, Office of Technology Assessment, 1991).
In 1979 the government initiated a substantial incentive scheme in terms of subsidised financing and capital depreciation allowances to promote investment in public and private research and development (Europa World Yearbook, 1991). A ten year Master Plan (1980 to 1990) was launched by the government to boost the technology base. This included the setting up of the Singapore Science Park for industrial and scientific institutions and the Selectar Air Base for the aeronautics industries.

The major defence industries in Singapore are government owned (Congress of the United States, Office of Technology Assessment, 1991). The government owned Chartered Industries of Singapore, founded in 1967, was transformed into the Singapore Technologies Corporation in 1983. STC is a corporation of 47 companies grouped in industrial, aerospace, marine and ordnance sectors. The subsidiary companies are run on a commercial basis and steps were taken towards privatisation in 1991.

The Singapore Technologies Aerospace company carries out overhaul and upgrade work on the C-130 military/civil transporter aircraft for the US Navy and also assembly of the Aerospatiale Super Puma helicopters (Jane's All the Worlds' Aircraft 1995). The company carries out engine overhaul for Pratt and Witney, General Electric and Northrop Grumman and component manufacture for F-16 and F5E/F fighter aircraft. In 1988 STA set up a joint venture with British Aerospace whereby STA carried out manufacture, repair and integration of B.Ae systems in return for marketing services.
The shipbuilding companies have used licensed production, for example Singapore Shipbuilding and Engineering have licence-built five Type-62 corvettes from Germany (Jane's Fighting Ships, 1995). France has awarded a repair and overhaul contract for the French Indian and Pacific Oceans fleet. All of the seven warships under construction for Singapore in 1995 were built domestically and none were being imported from overseas (Jane's Fighting Ships Special Report, 1995).

9.4.5 Thailand

The defence industry of Thailand is minimal and there is no indigenous production of major weapon systems (Forecast International, 1993). Small arms production was started in 1969 and in the 1990s Thailand had almost achieved self-sufficiency in small arms, artillery and ammunition (Forecast International, 1993). Thailand has a low level of production of aircraft components. There is heavy reliance on foreign technology and designs for military production. Thailand does have a military and paramilitary shipbuilding capability. Licensed ship-building has been important. Licence arrangements have been made for Thalang mine countermeasures craft (in 1980) and Fantrainer training ships (in 1983 to 1991) from Germany, Province class fast attack craft (1989 to 1992) from the UK and PS-700 landing ships from France (1984 to 1989) (Willett, 1996). In 1995 all four of the warships under construction for Thailand were being supplied from abroad and none were being built domestically (Jane's Fighting Ships Special Report, 1995).
9.4.6 Philippines

The Philippines is a relatively poor country within ASEAN, with a small military equipment budget (Bonsignore, 1993). The Armed Forces of the Philippines has historically been responsible for arms production and until the 1990s private sector arms production was illegal (Forecast International, 1993). Arms production is carried out in the manufacture of small arms, ammunition, and communications equipment. The country has a shipbuilding industry and in 1995 sixteen warships were under construction for the Philippines, twelve being imported and four being produced domestically. There has been very low level of licensed production of military equipment. In 1992 there was a licensed production deal valued at $57 million for 150 armoured personnel vehicles from the UK (SIPRI, 1993).

The Philippine aircraft industry is still in its infancy, carrying out licensed production of mainly light aircraft and maintenance. The government established the Philippine Aerospace Development Corporation, PADC, in 1973 in order to develop an aviation industry (Jane's All the Worlds Aircraft, 1995). The PADC carries out aircraft manufacturing, assembly, servicing, maintenance and sales. PADC completed licensed production of 18 jet trainers type S.211 from Agusta of Italy in 1993 and a further six were built in 1994 (Jane's All the Worlds' Aircraft, 1995). The purchase of two Italian SF.600 aircraft in 1995 accompanied a licensed production arrangement for local assembly of an additional number of aircraft. The Philippine Helicopter Services Inc carries out maintenance and overhaul for BO 105 helicopters, Hughes McDonnel Douglas helicopter rotor blades, Allison turbine engines, Textron Lycoming and Teledyne Continental engines. The PADC also carries out US Foreign
Military Sales work for the US company Sikorsky Helicopters. The international company Eurocopter International uses PADC as the Philippine agent for government and military sales and as a service centre. A subsidiary of PADC, the Philippines East Asia Cargo Airlines Inc, PEAC, was formed in 1990 as a joint venture between PAC and the Australian company Transnational Transport, TNT, to provide an international freight service (Jane's All the Worlds Aircraft, 1995).

The Philippine Aircraft Company Inc builds and carries out marketing functions for the PACI Skyfox light aircraft from USA SkyStar Corporation under an agreement announced in 1987. Initial local production of the PACI Skyfox started in 1988. PACI also manufactures aircraft components for other US companies (Jane's All the Worlds Aircraft, 1995).

9.4.7 Vietnam

Vietnam is a poor country with very large armed forces (Bonsignore, 1993). In 1989 the government introduced an economic stabilisation program and by 1991 work was underway on a government initiative to establish an export-processing zone, the purpose of which was to increase skilled employment, introduce new technology and attract foreign investment (Europa World Yearbook, 1991). Vietnam has considerable petroleum reserves and the government set up petroleum exploration schemes in 1990 with foreign petroleum companies. The country has a shipbuilding capability and an embryonic electronics industry but by 1995 had not established a sufficiently diverse industrial base to support sophisticated arms manufacture. The country did have the capability to maintain and even upgrade arms but not carry out
manufacture (Karniol, 1996a).

The forces are equipped with mainly Russian arms and ex-US equipment abandoned by the Americans at the end of the Vietnamese war (Jane's Fighting Ships, 1995). From 1978 to 1990 the USSR provided ex-Soviet ships and fuel in return for the use of a Russian naval base at Cam-Ranh Bay near Phan Rang in South Vietnam (Jane's Fighting Ships, 1995). After 1991 further transfers of equipment were carried out on a more formal basis and transfers were negotiated at market prices. American ships were cannibalised for spares, scrapped or sold and although many remain in naval bases are unoperational. The air force operates Russian fighter aircraft including MiG-32 and Su-33 ground attack aircraft and in 1993 purchased the Su-27 Flanker aircraft (Cloughly, 1995). The army is equipped with Russian tanks but none are licensed manufactured in Vietnam (Jane's Armoured Fighting Vehicles, 1993). Up to 1995 Vietnam's traditional arms supplier, the former Soviet Union, did not arrange licensed manufacture of arms in Vietnam as it did in the Warsaw Pact countries and in India which was also a major customer country (SIPRI database, 1995). An agreement was made in 1994 on the supply of Russian missile boats, radars and fighter aircraft and in 1996 plans were underway for a joint venture between Vietnam and Russia on the construction in Vietnam of frigates and fast attack craft, air defence radars and surface-to-air missiles (Karniol, 1996a).

Vietnam is pursuing a policy of attempting to expand trade and build closer ties with its neighbours (Cloughly, 1995). In the 1970s Vietnam developed a very close relationship with Russia, and in 1978 joined CMEA, the Council for Mutual
Economic Assistance (member states Bulgaria, Cuba, Czechoslovakia, Hungary, Mongolia, Poland, USSR, Vietnam) (Europa World Yearbook, 1991). In 1990 and 1991 the Soviet economy declined and financial assistance to Vietnam was substantially reduced. A first step to end isolation from the west and from the non-communist world was taken when Vietnam assumed diplomatic relations with America in July 1995 and joined ASEAN in August 1995 (Cloughly, 1995).

9.4.8 Conclusion

1. A striking feature of the ASEAN countries in the 1980s and 90s has been strong economic growth. The priority has not been building stronger military forces but on commercial growth. As SIPRI (SIPRI Yearbook, 1993) points out, as major international threats decrease and internal security issues become more important, military expenditure increasingly follows the economic trends of the country. South East Asia's defence expenditure has risen as a proportion of world defence expenditure from 15% in 1980 to 25% in 1991. The traditional arms suppliers in USA, Russia and Europe having seen their domestic markets declining in the 1980s and 90s have sought to gain a share of the ASEAN arms market. However, the ASEAN countries have strong national identities and are seeking increasing self reliance in arms production. The USA, European and Russian defence exporters have offered technology transfer in sales negotiations enabling the recipient countries to develop their own military equipment manufacturing capability.
2. Embargoes were experienced by Indonesia in the 1950s and 60s and this led to a desire to decrease reliance on the then current supplier nations by switching to other suppliers. In the 1990s many countries were very keen to supply arms which slightly decreased the reliance on specific nations, but the ASEAN countries continued to strive for improved self-reliance. The ASEAN countries have reached different levels in arms production capability. In 1995 Singapore had the most advanced domestic arms industry of the ASEAN countries and Brunei had none.

3. The level of state involvement has been particularly important in the setting up of a defence industry in Indonesia, Malaysia and Singapore, the Indonesian government with its policies of a dual function defence industry and countertrade bargaining, Malaysia with its countertrade policy and Singapore with its high level of industrial incentives and investment. All the ASEAN countries except Brunei had or in 1996 were negotiating licensing agreements as a means of achieving arms production. The use of joint ventures and licensed production has imported technology and provided skill to the local labour force to such an extent that Indonesia, Malaysia, the Philippines and Singapore have been able to set up aircraft maintenance and overhaul centres.
9.5. CONCLUSIONS

The effects of reduced world military expenditure since 1987 on the defence industries of different countries has varied greatly. Reduction in arms production has been made in the world's leading arms producing countries whereas the setting up and continued increase of arms production is seen in some areas including some of the emerging nations. The countries studied in this section Australia, Israel, Japan and the ASEAN countries have increased the level of arms production. The case studies failed to support the hypothesis that licensed production leads to indigenous production. The reasons and the mechanisms used for setting up and retaining arms production vary from country to country and within a country have varied with time as circumstances changed.

Australia

The Australian arms industry has grown three-fold in turnover in the decade 1982 to 1992 mainly as a result of the government's policy on achieving self-reliance (as described in Section 9.1 above). Australia gained advanced technologies and arms manufacturing capability through licensing agreements and manufactures highly sophisticated systems. The government has initiated schemes to support an arms export market in order to sustain its domestic defence industry.

Israel

Israel has developed a substantial arms industry at very high cost as described in section 9.2 above. The military expenditure per capita of population is the sixth
highest in the world, Israel has been prepared to pay the price of developing a sophisticated arms industry for political and security reasons, having experienced more than nine arms embargoes in forty years. Industry in Israel has gained support from USA by financial assistance and by licensing arrangements for high technology weapon system manufacture.

Japan

Japan's arms industry has grown in line with the growth rate of its gross national product (as described in section 9.3 above). Japan is one of the world's leading industrial powers and has the capability of manufacturing nearly all of its military equipment. Even though Japan is a pacifist nation under its constitution Japan is sixth in the world ranking of military expenditure and the Japanese defence industry has a substantial and steady domestic market. Many of the major Japanese industries have been involved in licensed production of weapon systems. The military production is strongly supported by the sophistication of commercial high technologies in which the advance has been driven by strong commercial markets, for example in consumer electronics.

ASEAN

Section 9.4 above described how the ASEAN countries have experienced strong economic growth and military expenditure has risen with the economic growth. Industrial expansion in ASEAN has included expansion in the defence industries. The use of joint ventures and licensed production has been a strong feature in countries such as Indonesia which are relatively new to arms production and in
countries such as Singapore which have established arms industries.

**Increased self reliance and ensured security of supply**

The main impetus for the establishment of arms manufacturing has been the value put on increased self reliance and ensured security of supply. Section 9.4.2 above described embargoes experienced by Indonesia in the 1950s and 1960s which led to a desire to decrease reliance on the then current supplier nations initially by switching to other suppliers and then by establishing a dual function commercial/military industrial capability. The Australian government decided to increase self reliance in arms following an announcement in 1969 by the President of the USA that the country's allies in South East Asia would have to mount their own defences against military threats and it was realised that Australian forces were nearly wholly dependant on imports for defence equipment (as described in section 9.1 above). By the 1990s self reliance was a part of Australia's defence policy. Israel which has been in a state of perpetual military tension and war since its declaration in 1948 has experienced a sequence of arms embargoes at times of extreme national crisis. The Israeli government pursued a policy of self reliance as necessary to the survival of Israel and to free Israel from political pressure from the supplier countries (section 9.2.1 above). Since the 1950s the increasing technical progress in Japanese industry led to increased self reliance in aerospace and military production. The Japanese government was lobbied to support increased self-reliance by the powerful industrial groups in Japan and by the growing unease of USA in the 1980s and 90s in continuing the supply of military technology to Japan (section 9.3 above). The
emerging nations of the ASEAN with the exception of Brunei are seeking increased self-reliance in selected areas of arms production.

**Regional power aspirations**

Regional power aspirations have not played an obvious role in setting up domestic arms production although escalating military expenditure and an associated arms race in South East Asia has resulted in ASEAN, Australia and other countries in the region being aware of the need to influence neighbouring nations to promote regional security and stability. Japan's powerful military force and extensive weapons arsenal, mostly produced in Japan, are a display of regional power and a measure of the force which could be unleashed against an aggressor. The display is discrete and apparent to military observers while at the same time the pacifist policies of the Japanese constitution are given prominence and recognition. Israel, surrounded by heavily armed hostile neighbours, has to be seen as militarily powerful and its arms industry forms a valuable contribution to its military power.

Israel has experienced the political pressure exerted by supplier nations, not only in the extreme cases of arms embargoes, but also in having to consider the foreign policies of supplier countries. Examples of this were evident when the USA Nixon administration imposed political pressure on Israel during the 1968 to 1970 War of Attrition between Egypt and Israel, and again in 1973 to 1975 when political pressure was applied by the USA on Israel to accept a ceasefire to the Yom Kippur War. Israel itself sought to apply political pressure on China in connection with the supply
of Chinese ballistic missiles to Saudi Arabia, by agreeing to a series of joint military equipment developments based on Israeli technology.

**Cost implications**

Cost implications of self sufficiency have been of secondary consideration in the choice between domestic production or importing arms. In 1985 the Australian government provided funding to subsidise uncompetitive defence projects where imports would have provided cost saving in the short term, where defence contracts were considered strategically important and also where there were prospects of a valuable export market. Japan bore the cost of 1.2 billion yen for indigenous production of the Type 90 Main Battle Tank (one of three types of tank in the inventory of the Japanese defence forces in the 1990s) which was three times higher than the cost of the USA equivalent, the M1A1 Abrams tank.

**Licensed production**

The setting up of defence production has been closely linked to importing technology and promoting skill in the domestic labour force. Licensed production has been a key feature of defence manufacturing from the early stages of setting up an embryonic defence industry to licensing deals in established companies. The pattern of licensed production has been seen in the countries covered in this study. The Japanese defence industry was restarted after World War II by technology transfer and licensed production of US designed equipment and has been used for land, sea
and air weapons and military platforms. By 1995 the Japanese defence industry has become established and manufactures a wide range of weapons. In 1995 one third of Japanese missiles in use or in manufacture are of licensed design and two thirds of indigenous design. The largest missile manufacturer in Japan (in terms of numbers of missiles manufactured) has declared the intention of eliminating the dependence on licensed designs and has undertaken development projects to completely replace licensed with indigenous missile designs. Licensed production is being used in Australia and in all the ASEAN countries except Brunei in order to establish selected areas of industrial expertise, for example Australia in naval ship building, in Indonesia in shipbuilding and aircraft manufacture, and in Malaysia in aircraft components, repair and overhaul.

Examination of licensed production of naval ships in Australia showed that licensed production sets in place the skills and infrastructure for a defence industry, but does not necessarily lead to indigenous production of the type of systems previously built under license. The period of time between build requirements of similar types of ships can be as long as the operational lifetime of the system which in the case of a submarine is typically thirty years, by which time the state of the art will have progressed by six generations of technology. The licensed production does provide (a) opportunities for indigenous production of the associated systems and subsystems such as communications, command systems, weapons control etc. at the same time as the main licensed production, (b) provides the skills and puts into place the technology infrastructure in the domestic industry and (c) also provides the opportunity for support, maintenance and upgrade work for the operational lifetime
of the equipment which could be up to thirty years. The value of associated contracts which are carried out by domestic industry in connection with a licensed production programme are not readily visible and therefore a study collating the value of indigenous and licensed production may miss a proportion of the indigenous content of a defence programme.

Offsets

The terms offered and negotiated under offset deals and the benefits accrued by the recipient countries vary widely. The ASEAN countries incorporate offset deals into procurement programmes as a matter of policy. The Australian government hoped that the introduction of offset deals in the 1970s on arms imports would provide benefit to Australian industry but the results in terms of quantity and content of offset work proved disappointing in terms of technology transfer or commercial gain.

Government policy

Government support is a strong feature of military industrial capability. Australian and Israeli defence policies are based on self-reliance and have taken steps to maximise domestic arms production for their own forces requirements and also to promote arms exports to amortise costs over larger production runs. Government policy has strongly dictated the shaping of the defence industries in ASEAN. In Indonesia the government industrial policy is directed towards Dwi Fungsi or commercial/military dual function, whereby three quarters of a company's production
capacity is allocated to civil production and one quarter to military production in peacetime but which ramps up to surge production at a time of crisis. The country's industrialisation programmes, including offsets and countertrade deals, have been focused by the government on the shipbuilding and aerospace industries. Malaysian government has linked defence and economic development, for example the 6th Malaysian Plan of 1991 to 1995 has linked military procurement to industrial offset programmes. Singapore has demonstrated high levels of government involvement in the development of the defence industry. In the 1960s and 70s the government provided substantial investment in shipyards and encouraged foreign investment in the Indonesian aerospace industry. Foreign companies were given financial incentives and tax breaks to set up manufacture and repair facilities in Singapore. In the late 1970s the government initiated incentive schemes to promote investment in research and development. In Japan the main feature of government support to the arms industry has been the promotion of international co-operation in research and development and the arrangement of licensed production deals. Japanese industrialists have powerful lobby groups which bring influence to bear on government policy. The lobby groups proposed increased domestic share of defence procurement and the government five-year plan for 1991 to 1995 included plans aimed at reducing the reliance of Japanese industry on US sources. In Israel government involvement in the defence industry was important particularly in dealings and negotiations with USA. Military grants of approximately $1.8 billion annually from USA directly benefited Israeli industry for procurement, development and research programmes for aircraft, tanks, missiles and electronics systems.
Gradual introduction of increasingly complex technology

Defence manufacturing technology builds slowly starting with comparatively simple technology such as repair and overhaul (Indonesia, Malaysia, the Philippines and Singapore have been able to set up aircraft maintenance and overhaul centres), the design of medium technology systems such as tank turrets and then progressing to more skilled systems. An example is seen in the design of tank turrets in Israel in 1954 to the manufacture of fighter aircraft in 1990. Israeli engineers learnt skills by working on licensed manufacturing and by working in defence companies in foreign countries and bringing the skills back to Israel. Investment by foreign companies in setting up manufacturing facilities in countries where they wish to access the defence markets has also brought military technology to those countries.

Availability of capital and diversity of country's industrial base

The availability of capital and the presence of a diversified industrial base influence the ability to set up and retain a defence industry. Singapore and Japan, which have become highly industrialised nations with stable economies, have highly capable defence industries. The Philippines, Thailand and Vietnam with very limited industrialisation have very low levels of arms production. Brunei has a strong economy and with minimal military expenditure has no need for an arms industry. Australia has shown restraint in making capital available for arms production and has directed effort and funding to selected areas of arms production, for example to naval equipment in line with its defence policy.
Chapter 10

Survey by questionnaire
10. SURVEY BY QUESTIONNAIRE

A survey was carried out to find why countries set up indigenous arms production. The purpose of the survey was to test the hypothesis that licensed production of arms leads to indigenous production. The countries investigated were Australia, Japan, Israel and the ASEAN countries. The questionnaire was pretested and adjusted until such time as it proved understandable. Questionnaires were sent to arms dealers, defence industrialists, military and government authorities in these countries and also to arms dealers in Europe and in USA. The questionnaires were sent by post and by facsimile.

The questionnaire covered the motivation for setting up an arms industry, the characteristics which influence the ability of the country to do so and the strategies used to achieve a defence industrial base. The questionnaire asked for each of the aspects to be rated in importance and asked for comment on any other important issues relating to the reasons or methods for setting up arms production.

The responses to the survey were analysed on a personal computer using a commercially available Excel (1995) mathematical software suite. The questionnaire document is shown in Annex 10.1 and result of the survey is presented numerically in Tables 10.2 and graphically in Figures 10.3 to 10.8.
10.1 THE SURVEY FORM

The survey form is shown in Annex 10.1 and covered:

1. Motivation to establish an arms industry

1.1 Strategic Motivation

   Improved self reliance
   Ensured security of supply, e.g. against embargoes
   Regional power aspirations
   Local arms race

1.2 Political

   To import technology
   To upgrade skill in local labour
   To influence customer nations

1.3 Economic

   Cost reduction
   Save hard currency by minimising imports
   Potential earning of foreign exchange though export

2. Characteristics which influence or determine the ability to establish an arms industry.

   Availability of capital
   Diversified industrial base
   Level of state involvement e.g. government ownership or support.
   Access to export markets
3. Methods to establish defence industry

Direct investment by USA, Europe etc.

Joint ventures and licensed production

Employment of foreign defence experts

Copying equipment

Gradual increase of complexity, e.g. first servicing, then assembly, and production

Gradual increase in complexity of types of equipment, e.g. first small arms, then missiles, tanks, jet aircraft, etc.

The questionnaire covered the motivation for setting up an arms industry, the characteristics which influence the ability of the country to do so and the methods used to achieve a defence industrial base. The questionnaire asked for each of the aspects to be rated with a score of 1 to 5, where the value 1 indicated no importance and the value 5 indicated great importance. The questionnaire also asked for comment on any other important issues relating to the reasons or methods for setting up arms production.

The questionnaire was sent to 290 arms dealers, defence industrialists, military and government authorities in the countries being studied, Australia, Israel, Japan and ASEAN and also to arms dealers in Europe and in USA. The questionnaires were sent by post and by facsimile. The questionnaire was also sent to six defence experts, four of whom responded. The experts' responses were not recorded in the survey in order to limit the survey to prime sources but the documents and references
provided by the experts were included in country studies in Chapter 9.

10.2 RESPONSES TO THE QUESTIONNAIRE

Sixty three completed questionnaires were received which represented a 22% response rate of the total of 290 questionnaires sent. The highest response rate was from the group of arms dealers from Europe and USA many of whom are known to the current author. The lowest response rate was from Japan, 16% and the ASEAN countries, 7%.

10.3 RESULT OF THE SURVEY

The Table and Figure 10.3 presents a summary of the responses to the questionnaire. The questionnaire asked for each of the aspects relating to the setting up of indigenous arms production to be rated with a score of 1 to 5, where the value 1 indicated no importance and the value 5 indicated great importance. The table shows the mean values of the ratings for each of the criteria together with the standard deviation of the values. The table shows the result for each of the countries studied and also the result of the responses from the world's arms dealers.
TABLE 10.3 Result of the survey

<table>
<thead>
<tr>
<th>Strategic Motivation</th>
<th>World Dealers</th>
<th>Australia</th>
<th>Japan</th>
<th>Mean</th>
<th>StdDev</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1A Improved Self Reliance</td>
<td>4.32</td>
<td>0.15</td>
<td>4.95</td>
<td>0.24</td>
<td>4.99</td>
</tr>
<tr>
<td>1.1B Security of Supply</td>
<td>4.30</td>
<td>0.18</td>
<td>4.92</td>
<td>0.25</td>
<td>4.95</td>
</tr>
<tr>
<td>1.1C Regional Power</td>
<td>4.30</td>
<td>0.15</td>
<td>4.92</td>
<td>0.25</td>
<td>4.96</td>
</tr>
<tr>
<td>1.1D Local Arms Race</td>
<td>4.25</td>
<td>0.12</td>
<td>4.85</td>
<td>0.32</td>
<td>4.73</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Political Incentives</th>
<th>World Dealers</th>
<th>Australia</th>
<th>Japan</th>
<th>Mean</th>
<th>StdDev</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2A Import Technology</td>
<td>3.41</td>
<td>0.14</td>
<td>3.54</td>
<td>0.13</td>
<td>3.54</td>
</tr>
<tr>
<td>1.2B Lower Import Cost Skill</td>
<td>3.56</td>
<td>0.20</td>
<td>3.46</td>
<td>0.11</td>
<td>3.75</td>
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<tr>
<td>1.2C Tolerance Customer Nations</td>
<td>2.63</td>
<td>0.16</td>
<td>2.62</td>
<td>0.19</td>
<td>2.65</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Economic Motivation</th>
<th>World Dealers</th>
<th>Australia</th>
<th>Japan</th>
<th>Mean</th>
<th>StdDev</th>
</tr>
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<tbody>
<tr>
<td>1.3A Cost Reduction</td>
<td>2.88</td>
<td>0.10</td>
<td>2.64</td>
<td>0.15</td>
<td>2.68</td>
</tr>
<tr>
<td>1.3B Save Hard Currency</td>
<td>3.23</td>
<td>0.16</td>
<td>3.59</td>
<td>0.20</td>
<td>3.08</td>
</tr>
<tr>
<td>1.3C Potential for Earning Foreign Exchange</td>
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<td>0.13</td>
<td>3.27</td>
<td>0.17</td>
<td>3.25</td>
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<table>
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<tr>
<th>Methods of Establishing Defence Industry</th>
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<th>Japan</th>
<th>Mean</th>
<th>StdDev</th>
</tr>
</thead>
<tbody>
<tr>
<td>2A Vertical Integration by Europe &amp; US</td>
<td>2.97</td>
<td>0.16</td>
<td>3.14</td>
<td>0.19</td>
<td>3.22</td>
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<tr>
<td>2B Use of Joint Ventures and Licenced Products</td>
<td>3.43</td>
<td>0.14</td>
<td>3.60</td>
<td>0.17</td>
<td>3.55</td>
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<td>2C Build by Buying Domestic Equipment</td>
<td>2.21</td>
<td>0.12</td>
<td>2.67</td>
<td>0.20</td>
<td>2.63</td>
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<tr>
<td>2D Exporting</td>
<td>3.78</td>
<td>0.08</td>
<td>4.19</td>
<td>0.15</td>
<td>3.86</td>
</tr>
<tr>
<td>2E Strategy of Increasing Equipment Complexity</td>
<td>3.60</td>
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<td>3.97</td>
<td>0.14</td>
<td>3.85</td>
</tr>
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</table>

<table>
<thead>
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<th>Total number of responses</th>
<th>World Dealers</th>
<th>Australia</th>
<th>Japan</th>
<th>Mean</th>
<th>StdDev</th>
</tr>
</thead>
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<td>290</td>
<td>32</td>
<td>18</td>
<td>8</td>
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<td>8</td>
<td>51</td>
<td>40</td>
<td>18</td>
<td>12</td>
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</table>

<table>
<thead>
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<th>Total number of questionnaires sent</th>
<th>World Dealers</th>
<th>Australia</th>
<th>Japan</th>
<th>Mean</th>
<th>StdDev</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>105</td>
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<td>150</td>
<td>150</td>
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</tbody>
</table>
FIGURE 10.3a Result of survey by questionnaire indicating importance of criteria in setting up and maintaining defence industry.
FIGURE 10.3b Result of survey by questionnaire indicating importance of criteria in setting up and maintaining defence industry.
10.4 Australia: result of the survey by questionnaire on setting up arms production

Australia: motivation

The survey showed that the strategic motivation of improved self reliance and security of supply were considered the most important aspects of motivation in setting up and retaining a defence industry. The low value of standard deviation (0.61 and 0.46) shows that there was a fair level of agreement from the thirteen responses.

The political motivations of importing technology and upgrading skill in the local labour force and the economic motivations of the potential for earning foreign exchange, saving hard currency and cost reduction were also considered as important factors. The standard deviation values (1.01, 1.22, 0.80, 1.07 and 1.07) showed a slightly wider variation in agreement than in the case of the two leading motivating factors.

There was slightly higher variation in the response (standard deviations 1.23) that a requirement to influence customer nations had low importance but close agreement (standard deviation 0.74) that a local arms race was unimportant.

Australia: factors which influence the ability and methods to establish a defence industry

There was a very high level of agreement (standard deviation 0.58 and 0.78) in the
responses that the use of joint ventures and licensed production and the availability of capital were very important in the setting up and maintaining a defence industry. The other important aspects were the presence of a diversified industrial base, building up through complex stages and increasing equipment complexity, direct investment by European and USA arms suppliers, access to export markets and the level of state involvement (standard deviation 1.14, 0.66, 0.95, 1.22, 1.21).

Building by employing foreign experts and by copying equipment were considered unimportant (standard deviation 1.10 and 0.95).

10.4.1 Australia: comparison of results of the survey by questionnaire and by the country study.

The results showed strong agreement that the use of licensed production was very important. The country study showed that licensed production was widely applied and particularly to naval ship building in Australia. The country study also recorded that offset deals had failed to provide commercially or technically attractive contracts despite government action to monitor and improve offset performance. Comments on the responses to the questionnaire advised that

a) licensed production did not lead to the companies winning indigenous production orders but did assist in providing viable business and the technology and expertise to gain other contracts and
b) offset deals were considered a failure. There was reluctance to enter into offset deals by Australian defence contractors. There was mention of "metal bashing" which indicated low skill level work and "being treated as cheap offshore labour" which indicated the low profitability of contracts offered by leading arms supplier countries.

and the comments vividly reinforced the findings of the study.

The level of state involvement was assessed as being of importance in the questionnaire survey but the country study demonstrated very high levels of government policies and actions to provide support to the defence industries in terms of research funding, scheduling procurements, provision of funding for uncompetitive but important work, assistance in securing exports and in the government's policy of self-reliance in arms procurement. It might have been expected from the country study that the questionnaire survey would have assessed the level of state involvement as being of higher importance. If the responses to the questionnaire been been provided by a higher proportion of government contacts then the replies may have leant more weight to the importance of government involvement.

The country study recorded that several of the world's major arms contractors had set up subsidiaries and joint venture companies in Australia in order to gain a share of the Australian defence market. The investment by foreign contractors was recognised as being important in the responses to the questionnaire.
10.5 Israel: result of the survey by questionnaire on setting up arms production

Israel: motivation

The result of the survey by questionnaire showed that improved self reliance and security of supply were the leading motivating factors for Israel in setting up and retaining a domestic arms industry. The low values of standard deviation (0.63 and 1.12) demonstrated agreement between the thirteen responses. The motivation of the potential to earn foreign exchange, the local arms race and the need to upgrade the skill in labour ranked next in importance. The requirement to influence customer nations, the saving of hard currency, and the requirement for cost reduction were considered less important. The least important motivation to Israel according to the responses was regional power aspirations.

Israel: factors which influence the ability and methods to establish a defence industry

The responses to the survey questionnaire showed strong agreement (standard deviation 0.80) that the level of state involvement was extremely important in determining the ability to set up and retain the arms industry in Israel. There was also strong agreement that the existence of a diversified industrial base, the availability of capital and the access to export markets were of high importance to the Israeli defence industry.

The strategy of rising through the learning curve by building increasingly complex
equipment and through increasingly complex stages was considered as more important than copying equipment or taking part in joint ventures and licensed production contracts. Investment by other countries' arms producers and employing foreign experts was considered as of low importance.

10.5.1 Israel: comparison of results of the survey by questionnaire and results by the country study.

There was agreement between the survey by questionnaire and the result of the country study that self reliance and security of supply were the leading motivating factors in setting up and sustaining the arms industry in Israel. The country study detailed the history of arms embargoes and the political pressure applied by supplier countries at times of national crisis.

The result of the survey by questionnaire ranked the motivation of the potential to earn foreign exchange as important which corresponds to the country study findings that arms exports ranked third behind diamond export and tourism as Israel's top exchange earners. The country study showed that foreign earning through export, at a level of $237M per year, resulted from Israel being the world's twelfth largest arms exporter. The questionnaire result ranked the local arms race as important which corresponded to the evidence summarised in the country study that Israel was surrounded by hostile neighbours in a region characterised by high and sustained military expenditure.
Chapter 10

The result of the survey by questionnaire listed the strategy of building capability through increasing the complexity of the equipment being built and building systems through increasingly complex stages. The Israeli country study provided evidence of the expansion of arms manufacturing from the initial relatively simple operations to current state-of-the-art activities:

a) in the aircraft industry, where aircraft maintenance facilities were set up in Israel in the mid 1950s and progress has been made to the production and export of the high technology Kfir fixed delta-wing fighter aircraft.

b) from small arms and ammunition manufacture in the 1940s to the design and production in the 1980s of world-leading reactive armour for tank protection against armour-penetrating missiles.

The questionnaire result found that the strategies of copying equipment and of licensed production were considered as of less than medium importance. The country study indicates that this result is not surprising considering the history of licensed production which had been important from the 1950s until the embargoes associated with the Six-Day War in 1967 when Israel started its indigenous production programme. Also during the 1990s the USA became concerned about the loss of technology lead and refused Israel at least one request for a licensed production agreement.

The questionnaire result showed that employing foreign experts was of low
importance. One of the questionnaire reply documents pointed out that Israeli nationals worked in defence manufacturing plants all over the world and they brought the technology and the skills back to Israel so there was not a need to employ foreign experts. It was further pointed out that Israeli's received a high level of military technology training during compulsory conscription in the armed forces and many of the most capable then moved on to the Israeli defence industries, thus creating a pool of highly trained staff.
10.6 JAPAN: RESULT OF THE SURVEY BY QUESTIONNAIRE ON SETTING UP ARMS PRODUCTION

Japan: Motivation

The survey showed that the strategic motivation of improved self reliance and security of supply were considered the most important aspects of motivation in setting up and retaining a defence industry. The low value of standard deviation (0.60 and 0.70) shows that there was a fair level of agreement from the eight responses.

There was a similar level of agreement (standard deviations 0.60 and 0.66) that the need to upgrade local skill and to achieve cost reduction were of high importance, while the need to import technology was assessed as important. Rated as of less importance were the motivation to save hard currency and regional power aspirations.

Japan: Factors which influence the ability and methods to establish a defence industry.

There was high level of agreement (standard deviation 0.70 and 0.78) that the existence of a diversified industrial base and the availability of capital were the strongest factors influencing the ability to maintain a defence industry. Also assessed as being of high importance were the strategies of building through increasingly complex stages and building increasingly complex equipment. The level of state
involvement, joint ventures and licensed production, copying equipment and access to export markets were considered as having low importance.

Japan: Comparison of results of the survey by questionnaire and results by the country study.

The results of both the survey by questionnaire and the country study showed that the requirement for self sufficiency and security of arms supply were of high importance to the promotion of the Japanese arms industry. The country survey showed that self sufficiency in arms had been assessed as fairly high at 40% to 90% in the 1990s and the Japanese government's five year plan, Shin Chuki-Bofor, for the period 1991-95 included development plans specifically aimed at reducing industrial dependence on USA and achieving self-sufficiency in arms.

The result of the survey questionnaire showed the importance of upgrading skill and importing advanced technology. This result confirmed the findings of the country survey that the Japanese Government had directed effort for international cooperation in research and development in order to raise skill levels. The country survey also showed the development of aircraft, missile and arms industries in Japan had been based on technology transfer from USA.

The questionnaire survey showed that cost reduction was rated more highly than the need to save hard currency. The opposite view was indicated in the country report where it was reported that Japan had been willing to pay three times as much on
procurement of its indigenous Type 90 Main Battle Tank as the USA equivalent, the
M1A1 Abrams. The reason for Japan investing in the Type 90 Tank may have been
for cost saving in whole lifetime costs, self-sufficiency or for customisation to Japan's
operational requirements.

The survey by questionnaire found that the existence of a diversified industrial base
and the availability of capital were the strongest factors influencing the ability to
maintain a defence industry. This result corresponded to the country survey which
recorded that Japan is one of the world's leading industrialised nations with a highly
diverse industrial base and had the sixth highest military expenditure in the world.

The result of the questionnaire survey showed that strategies of building through
increasingly complex stages and building increasingly complex equipment were
considered of high importance which corresponded to the findings of the country
report. The country report also confirmed the finding of the survey by questionnaire
in the high importance of strategies of building up manufacturing capability through
increasingly complex stages and building increasingly complex equipment. The
example of the gradual stages of designing and manufacturing more complex parts
of tanks over forty years was illustrated in the country report.

The survey by questionnaire assessed the level of state involvement, joint ventures
and licensed production and the practice of copying equipment as not of great
importance. The country report has described the pacifist nature of the constitution,
the limitation of military expenditure and also how the powerful industrial groups
own the technology rights of the arms industry. These considerations would support the result of the questionnaire that state involvement was assessed as not of great importance. The country report showed how licensed production and technology transfer from USA had been important in the years since the early 1950s and that the Japanese arms industries had been largely based on production stemming from these licensing activities. In the 1990s the Japanese defence industrial capability has a substantially base on dual use technology, in which Japan is a world leader, and there is reduced dependence on US-originated technology. It was estimated that in the 1990s only 10 to 60% of Japanese arms production was based on non-Japanese technology. The country report indicated that the importance of joint ventures and licensed production has decreased as the Japanese defence industry had matured.

The survey by questionnaire indicated that access to export markets was not considered important, a result which did not correspond to the findings of the country study. The country study revealed that Japan was in 1991 the world's twentieth leading arms exporter. The reason for the result of the questionnaire in connection with arms exports is probably that the level of arms exports is not widely known but the regulations forbidding arms exports are widely quoted.
10.7 ASEAN: RESULT OF THE SURVEY BY QUESTIONNAIRE ON SETTING UP ARMS PRODUCTION

ASEAN: Motivation

The survey showed that the strategic motivation of improved self reliance and security of supply were considered the most important aspects of motivation in setting up and retaining a defence industry. The value of standard deviation (1.09 and 1.49) shows that there was not a very high level of agreement from the eight responses.

The survey showed that the need to upgrade the skill of local labour and to import technology were important political motivations to promote a domestic arms industry and important economic motivations were cost reduction and the need to save hard currency. Less important motivations were considered to be the potential for earning foreign exchange, the desire to influence customer nations and the influence of a local arms race.

ASEAN: Factors which influence the ability and methods to establish a defence industry

The result of the survey showed agreement (standard deviation 0.71) that the level of state involvement ranked very highly in importance in the setting up and sustaining an arms industry. Also ranked as important were a diversified industrial
base, the availability of capital, the building up from comparatively simple to more complex procedures and systems, the use of joint ventures and licensed production and access to exports.

The survey showed that employing foreign experts and direct investment by US and European arms suppliers was of less importance and the strategy of copying equipment was of least importance.

ASEAN: Comparison of results of the survey by questionnaire and results by the country study.

The survey by questionnaire showed that the strategic motivation of improved self reliance and security of supply were considered the most important aspects of motivation in setting up and retaining a defence industry. The country studies showed that the arms industries of Singapore were the most advanced of ASEAN and the other countries had very immature arms industries. Indonesia had experienced arms embargoes and there were attempts to structure the arms industry to provide continuity of supply at a time of crisis.

The survey by questionnaire showed that the need to upgrade the skill of local labour and to import technology were important political motivations to promote a domestic arms industry and important economic motivations were cost reduction and the need to save hard currency. The countries study showed that the ASEAN countries have had strong economic growth in the 1980s and 1990s and the countries
have been attempting to increase the level of industrialisation by a variety of methods including importing technology and training programmes.

The result of the survey showed agreement that the level of state involvement ranked very highly in importance in the setting up and sustaining an arms industry. The countries study showed a very high level of state involvement in Indonesia (policy on dual function civil/military industry, policy on countertrade), Malaysia (policies on technology transfers, offset deals) and Singapore (incentive schemes, investment policies).

The result of the survey by questionnaire showed that a diversified industrial base, the availability of capital, the building up from comparatively simple to more complex procedures and systems, the use of joint ventures and licensed production and access to exports were ranked as important. These findings were supported by the countries study. The countries survey showed that most highly developed defence industry within ASEAN was in Singapore which has a highly diversified industrial base and also has one of the highest military expenditures within ASEAN which would indicate the availability of capital. The countries study also showed that defence industries were beginning in the setting up of repair and overhaul facilities for example in Malaysia (aircraft industry), Philippines (aircraft industry) which illustrated a comparatively simple start for progression to more complex undertakings. The countries report confirmed the importance of licensed production agreements in Thailand (shipbuilding), Indonesia (aircraft), Malaysia (vehicles), Philippines (aircraft) and Singapore (shipbuilding).
The survey by questionnaire gave the result that investment by US and European companies was not considered important in ASEAN countries. It may be that some potential western investment could be inhibited by the impounding of British companies' property in Indonesia in 1963. The countries report did show a level of investment by western arms companies, for example in Singapore. Malaysia and Singapore have actively sought investment by foreign high technology companies.
10.8 T-TESTS: RESULT OF T-TESTS (TWO-TAILED DISTRIBUTION TEST) OF RESPONSES TO THE QUESTIONNAIRE

The set of tables, Tables 10.8, presents the probability associated with the two-tailed t-test in the testing of the sets of data for each of the countries examined. It would have been acceptable to use a \( \chi^2 \) test but the data lent itself better to a two-tailed T-test. The T-tests measure the degree of similarity between the responses from the different countries and provides a value, P, for the probability or level of confidence of whether there is significance in the similarity between the data for one country and the data for each other country. A high probability value of 1 indicates strong similarity in the data for the countries being compared, for example Australia and Israel assessed the importance of earning foreign exchange in a similar way and both gave high rating to this aspect of economic motivation. A low probability of zero indicates significant difference in the sets of data for the countries being compared. The low probability values of zero, for example between Japan and the other countries on value of access to the arms export market, shows the high significance of the difference between the responses of the countries which results from Japan's policy on disallowing the export of arms.

The results of the T-tests show that the differences in responses between countries (average value of P is 0.34) is statistically significant which demonstrates that the importance of reasons for setting up arms production varies from country to country.
Table 10.8.10 Probability values, P, of the T-test comparing the data for Australia with the data for Japan, Israel and the Asean countries.

<table>
<thead>
<tr>
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<th>Australia</th>
<th>Australia</th>
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<td>Israel</td>
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<td>0.83</td>
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<tr>
<td>1.1C Regional Power</td>
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<td>0.37</td>
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<td>1.1D Local Arms Race</td>
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<td>0.26</td>
<td>0.00</td>
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<tr>
<td>1.2C To Influence Customer Nations</td>
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<td>3B Use of Joint Ventures and Licenced Production</td>
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<td>3C Building by Employing Foreign Experts</td>
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<td>3F Strategy of Increasing Equipment Complexity</td>
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Table 10.8.20 Probability values, P, of the T-test comparing the data for Japan with the data for Australia, Israel and the Asean countries.

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<td>1.2C To Influence Customer Nations</td>
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<td>2A Availability of Capital</td>
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Table 10.8.30 Probability values, P, of the T-test comparing the data for Asean countries with the data for the Australia, Japan and Israel.

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Table 10.8.40 Probability values, $P$, of the T-test comparing the data for Israel with the data for the Australia, Japan and the ASEAN countries.

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<tr>
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<td>1.3C Potential for Earning Foreign Exchange</td>
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<td>0.00</td>
<td>0.34</td>
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<tr>
<td><strong>Influences the Ability</strong></td>
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<td></td>
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<tr>
<td>2A Availability of Capital</td>
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<td><strong>Methods of Establishing a Defence Industry</strong></td>
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<tr>
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<td>3F Strategy of Increasing Equipment Complexity</td>
<td>0.10</td>
<td>0.24</td>
<td>0.17</td>
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Table 10.8.50 Probability values, P, of the T-tests comparing the data provided by the world dealers (i.e. from Europe and from USA) with the data for Australia, Japan, Israel and the Asean countries.

<table>
<thead>
<tr>
<th>Strategic Motivation</th>
<th>World Dealers</th>
<th>Israel</th>
<th>Asean</th>
<th>Japan</th>
<th>Australia</th>
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<tr>
<td></td>
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<td>1A Improved Self Reliance</td>
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<td>1B Security of Supply</td>
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<td>0.00</td>
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<td>Political Motivation</td>
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<tr>
<td>1A bubbles</td>
<td>0.28</td>
<td>0.25</td>
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<tr>
<td>1B Implant Technology</td>
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<td>0.06</td>
<td>0.04</td>
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<td>1C Upgrade Local Skill</td>
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<td>0.00</td>
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<tr>
<td>Economic Motivation</td>
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<td>1A Cost Reduction</td>
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<td>1B Save Hard Currency</td>
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<td>0.32</td>
<td>0.50</td>
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<tr>
<td>1C Potential for Earning Foreign Exchange</td>
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<td>0.89</td>
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<td>1D Access to Export Market</td>
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<td>0.90</td>
<td>0.89</td>
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<tr>
<td>Influence the Ability</td>
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<td></td>
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<tr>
<td>2A Availability of Capital</td>
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<td>0.09</td>
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<tr>
<td>2B Ability to Influence Industrial Base</td>
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<td>0.68</td>
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<td>2C Level of State Involvement</td>
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<td>0.82</td>
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<tr>
<td>Methods of Establishing a Defence Industry</td>
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<tr>
<td>3A Direct Investment by Europe &amp; US</td>
<td>0.05</td>
<td>0.87</td>
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<td>3B Use of Joint Ventures and Licensed Production</td>
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<td>0.50</td>
<td>0.04</td>
<td>0.01</td>
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<tr>
<td>3C Building by Exporting Equipment</td>
<td>0.01</td>
<td>0.33</td>
<td>0.00</td>
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</tr>
<tr>
<td>3D Building by Copying Complex Stages</td>
<td>0.02</td>
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<td>0.00</td>
<td>0.00</td>
<td></td>
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<tr>
<td>3E Strategy of Increasing Equipment Complexity</td>
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<td>0.19</td>
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<tr>
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<td>0.30</td>
<td>0.30</td>
<td>0.42</td>
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</tr>
</tbody>
</table>
10.9 RESULT OF THE SURVEY

The respondents in the survey indicated that motivation, the ability and the methods used have influence on the level of success in setting up and maintaining an arms industry.

The Figures 10.9 include:

Figure 10.9.1 Strategic motivation

Figure 10.9.2 Political Motivation

Figure 10.9.3 Economic Motivation

Figure 10.9.4 Criteria influencing the ability to set up indigenous arms manufacturing

Figure 10.9.5 Methods of establishing an indigenous arms industry

The Figures 10.9 provide a graphical presentation of the data provided in the responses to the questionnaire. The questionnaire asked for each of the aspects relating to the setting up of indigenous arms production to be rated with a score of 1 to 5, where the value 1 indicated no importance and the value 5 indicated great importance. The figures are presented in a "3d-riser" format. The vertical axis represents score rating of importance on the scale 1 to 5, for each of the countries.
and each of the criteria.
Figure 10.9.1  Values of importance of strategic motivations for establishing a defence industry
Figure 10.9.2 Values of importance of political motivations for establishing a defence industry

![3D Bar Chart showing political motivations and their values for different regions and motivations.]

**Political Motivation**

- **Upgrade Local Skill**
  - Values: 5, 4, 3, 2, 1, 0

- **Import Technology**
  - Values: 5, 4, 3, 2, 1, 0

- **World Dealers**
  - Values: 5, 4, 3, 2, 1, 0

- **Australia**
  - Values: 5, 4, 3, 2, 1, 0

- **Japan**
  - Values: 5, 4, 3, 2, 1, 0

- **Asean**
  - Values: 5, 4, 3, 2, 1, 0

- **Israel**
  - Values: 5, 4, 3, 2, 1, 0

- **Influence Customer Nations**
  - Values: 5, 4, 3, 2, 1, 0

- **Upgrade Local Skill**
  - Values: 5, 4, 3, 2, 1, 0

- **Import Technology**
  - Values: 5, 4, 3, 2, 1, 0

Page 317
Figure 10.9.3 Values of importance of economic motivations for establishing a defence industry

Economic Motivation
Figure 10.9.4 Values of importance of criteria influencing ability to establish a defence industry
Figure 10.9.5  Values of importance of methods of establishing a defence industry

Methods of Establishing a Defence Industry

<table>
<thead>
<tr>
<th>Method</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Equipn World Dealers</td>
<td>5</td>
</tr>
<tr>
<td>Increase Complexity</td>
<td>4</td>
</tr>
<tr>
<td>Complex Stages</td>
<td>3</td>
</tr>
<tr>
<td>Copying Equipment</td>
<td>2</td>
</tr>
<tr>
<td>Employ Foreign Experts</td>
<td>1</td>
</tr>
<tr>
<td>Licenced Production</td>
<td>0</td>
</tr>
<tr>
<td>USA/European investment</td>
<td>0</td>
</tr>
</tbody>
</table>

World Dealers | Australia | Japan | Asean | Israel
Motivation

The result of the survey indicated that the motivation to set up an arms industry is primarily strategic and secondly political and the economic aspects carry less importance. In the countries studied, the motivation is based on the following factors in descending order of importance:

1. Improved self reliance (strategic)
2. Ensured security of supply, e.g. against embargoes (strategic)
3. To upgrade skill in local labour (political)
4. To import technology (political)
5. Save hard currency by minimising imports (economic)
6. Potential earning of foreign exchange though export (economic)
7. Cost reduction (economic)
8. To influence customer nations (political)
9. Regional power aspirations (strategic)
10. Local arms race (strategic)

There was close correlation between the countries on the levels of importance of strategic motivation, but Israel gave higher ranking than the other countries to the importance of a local arms race. This result corresponded to the report in the country study which described the Middle East as being an area of high military expenditure. Political motivation ranked of higher importance in Australia than in Japan or ASEAN countries. This result corresponded to the political importance on defence
industrialisation described in the country study. The lower ranking of importance of political motivation in Japan in comparison to the other countries reflects the existing high technology status of Japan's industries and a lower need to import technology and upgrade skills. Comparison of countries' economic motivation showed the low ranking by Japan of the potential to earn foreign exchange, which reflects Japan's policy prohibiting the export of weapons.

**Ability to set up an arms industry**

The factors influencing the ability to set up and maintain an arms industry in the countries studied were, in descending order of importance.

1. The availability of capital
2. A diversified industrial base
3. The level of state involvement
4. Access to an export market

Both ASEAN and Israel ranked the level of state involvement highly in comparison to the other countries. This reflects the high level of state involvement in supporting and sustaining the arms industry in Israel and in the governments' efforts to nurture embryonic arms industries in ASEAN.
Methods to establish an arms industry

The importance of methods employed to establish and maintain an arms industry in the countries studied were, in descending order of importance:

1. Building equipment through increasingly complex stages of manufacture for example by first setting up repair and maintenance facilities, then assembly and progress to full design and manufacture.
2. Strategy of building increasingly complex equipment, for example starting with ammunition, vehicles, ships, weapons to highly complex systems such as fighter aircraft.
3. Use of joint ventures and licensed production.
4. Direct investment by European or US arms suppliers
5. Building by copying designs
6. Building by employing foreign experts

There was similarity in high ranking of the level of importance of increasing the complexity of manufacturing operations and the types of equipment being built. Japan rated the other four methods, copying, employing foreign experts, licensed production and western investment, at significantly lower levels of importance than did the other countries. This probably results from Japan's technology lead particularly in dual use technologies and consequently a reduced need to develop existing skills. The world dealers and Israel gave higher ranking to the importance of copying equipment than did the other countries. It may be the case that world
dealers are more willing to recognise close similarities between systems which have been imported and systems which have been later designed indigenously and resembling the imported models.

Examination of the importance of licensed production shows that Japan and Israel, both countries with advanced arms industries, ranked licensed production as significantly lower importance than did Australia, ASEAN or the western arms dealers. The significance of this difference may be that Australia and ASEAN are striving to build up a technically advanced arms industry and are using licensed production to achieve advancement. Western arms suppliers are letting licensing agreements to countries including emerging supplier nations in order to gain market share in those countries. In contrast, Japan and Israel had high levels of licensed production in the past when the defence industries were less mature. The country study reported that Japan had implemented a policy to reduce dependence on foreign technology in arms production.
10.10 CONCLUSION

The survey by questionnaire examined the reasons and mechanisms for countries setting up and retaining arms production. The results of the survey for ASEAN, Australia, Japan and Israel were compared with the findings of the country studies. The survey failed to support the hypothesis that licensed production leads to indigenous production. The survey by questionnaire showed that the motivation to set up an arms industry is primarily strategic, secondly political and that economic motivation carries less importance.

The importance of different methods used to establish an arms industry varied from country to country, and within a country varied as the industries matured. Initially arms production is limited to ammunition and small artillery. The setting up of ship or aircraft maintenance and overhaul provides a mechanism to introduce a defence industrial capability. Manufacture under license introduces an increasingly complex manufacturing capability and infrastructure which enables indigenous manufacturing to be undertaken. As the arms industries became more mature the importance of licensed technology and technology transfers became less important.
Chapter 11

Conclusions
11.1 THE HYPOTHESIS BEING INVESTIGATED

On 3rd September 1939 the Second World War began and George Bernard Shaw wrote the prophetic words "There will be only two winners: the United States and the Soviet Union". For several decades following the end of World War II western and Soviet defence industries thrived on largely stable and steadily growing defence markets. This was based on the military balance of the cold war and the policy of deterrence between NATO and the Warsaw Pact. By 1987 the level of the world's military expenditure peaked at $2 million per hour. In 1989 the end of the cold war was brought about by diplomatic and political change in the East and in West and the defence industries were faced with long term decline in domestic and world markets. By 1991 the level of military expenditure had fallen by twenty per cent in five years to the level of $1.6 million per hour.

The world's major arms suppliers were forced to adjust to the declining market by downsizing, mergers and acquisitions, diversifying and by seeking an increased market share in other countries. While there were decreasing arms industries in the main supplier countries, other countries, and particularly the emerging nations with growing economies increased the level of arms production. The traditional arms suppliers competed to gain market share in the steady and increasing markets of these countries and offered technology transfers, offsets and licensed production arrangements. Countries such as those in the Pacific Rim with emerging economies and a growing technology base, are no longer willing to accept western equipment without some form of counter trade. They want to "catch up" with Europe and North America and believe they have the bargaining edge to do so. Supplier countries are being asked to enter into licensed manufacturing arrangements, offset, counter trade and technology transfer agreements to set up in-country manufacture. The traditional arms importing countries developed defence manufacturing skills and increased the domestic arms production in terms of value and also in the sophistication of the weapons being built. Within the domestic arms production an increasing level of indigenous design and manufacture is carried out. The arms industrialists of the traditional supplier nations have become concerned that licensed manufacturing leads to the countries eventually setting up their own production. The supplier would then lose that country as a customer and also introduce another potential supplier to
compete in the world market. The relationship between licensed and indigenous production of arms presented a fruitful area of research. A literature search did not identify any research which had undertaken an analysis of this relationship.

The hypothesis being investigated in this study is that licensed production leads to indigenous production of arms.

11.2 METHODS USED TO TEST THE HYPOTHESIS

Three methods were used to test the hypothesis: (a) a macro-analysis of the numerical data collated on twelve countries arms production, (b) a study of the arms production of the ASEAN and three other countries and (c) a survey by questionnaire of arms dealers and suppliers.

11.2.1 The macro-analysis

Method

Data was taken from the SIPRI database (SIPRI, 1993) on the value of trade, licensed production and indigenous production of major weapons over a twenty-five year period. The countries covered were twelve emerging nations, which are listed by SIPRI as developing countries: Argentina, Brazil, Chile, Egypt, India, Indonesia, Israel, Pakistan, Singapore, South Africa, South Korea and Taiwan. The twenty-five year period was from 1965 to 1990.

Result

The macro-analysis did not support the hypothesis that licensed production of arms measured by value results in indigenous production of arms measured by value. The macro-analysis showed that the value of the indigenous production of arms is not dependent on the value of licensed production in previous years, but is related to the current year value of licensed production. This showed that the value of indigenous arms production is not a result of the value of licensed production, but rather the values of indigenous production and licensed production are both the result of another
cause.

If the value of indigenous production had resulted from the value of licensed production then there would have been a meaningful time lag between the value of licensed production and a later value of indigenous production.

11.2.2 Country studies

Method

The country studies examined the setting up of arms production in three countries Australia, Japan and Israel and the countries of the Association of South-East Asian Nations, ASEAN. The countries examined provide a range of military settings, from a country with no major threats to a country in an almost perpetual state of war and to an area overshadowed by an arms race, from a major industrial power to countries with limited industrial development and from financially secure countries to countries with struggling economy.

Result

The study found that whilst world military expenditure had declined since 1987 there was increased level of arms production in the countries selected for study, Australia, Israel, Japan and the ASEAN countries. The study did not support the hypothesis that licensed production leads to indigenous production. Instead the study showed that the reasons and the mechanisms used for setting up and retaining arms production varied from country to country and within a country have varied with time as circumstances changed.

Licensed production

The study found that the setting up of defence production was closely linked to importing technology and promoting skill in the domestic labour force. Licensed production has been a key feature of defence manufacturing from the early stages of setting up an embryonic defence industry to licensing deals of highly complex
defence equipment in established companies. The pattern of licensed production was seen in the countries covered in this study. The Japanese defence industry was restarted after World War II by technology transfer and licensed production of US designed equipment and has been used for land, sea and air weapons and military platforms. By 1995 the Japanese defence industry has become established and manufactures a wide range of weapons. In 1995 one third of Japanese missiles in use or in manufacture are of licensed design and two thirds of indigenous design. The largest missile manufacturer in Japan declared the intention of eliminating the dependence on licensed designs and has undertaken development projects to completely replace licensed with indigenous missile designs. Licensed production is being used in Australia and in all the ASEAN countries except Brunei in order to establish selected areas of industrial expertise, for example Australia in naval ship building, in Indonesia in shipbuilding and aircraft manufacture, and in Malaysia in aircraft components, repair and overhaul.

Examination of licensed production of naval ships in Australia showed that licensed production sets in place the skills and infrastructure for a defence industry, but does not necessarily lead to indigenous production of the type of systems previously built under licence. The period of time between build requirements of similar types of ships can be as long as the operational lifetime of the system which in the case of a submarine is typically thirty years, by which time the state of the art will have progressed by six generations of technology. The licensed production does provide (a) opportunities for indigenous production of the associated systems and subsystems such as communications, command systems, weapons control etc. at the same time as the main licensed production, (b) provides the skills and puts into place the technology infrastructure in the domestic industry and (c) also provides the opportunity for support, maintenance and upgrade work for the operational lifetime of the equipment which could be up to thirty years. The value of associated contracts which are carried out by domestic industry in connection with a licensed production programme are not readily visible and therefore a study collating the value of indigenous and licensed production may miss a proportion of the indigenous content of a defence programme.
Gradual introduction of increasingly complex technology

The country studies showed that defence manufacturing technology builds slowly starting with comparatively simple technology such as repair and overhaul (Indonesia, Malaysia, the Philippines and Singapore have been able to set up aircraft maintenance and overhaul centres), the design of medium technology systems such as tank turrets and then progressing to more skilled systems. An example was seen in the progress from the design of tank turrets in Israel in 1954 to the manufacture of fighter aircraft in 1990. Israeli engineers learnt skills by working on licensed manufacturing and by working in defence companies in foreign countries and bringing the skills back to Israel. Investment by foreign companies in setting up manufacturing facilities in countries where they wish to access the defence markets also brought military technology to those countries.

Increased self reliance and ensured security of supply

The country studies emphasised the importance of increased self reliance and ensured security of supply. Embargoes were experienced by Indonesia in the 1950s and 1960s which led to a desire to decrease reliance on the then current supplier nations initially by switching to other suppliers and then by establishing a dual function commercial /military industrial capability. The Australian government decided to increase self reliance in arms following an announcement in 1969 by the President of the USA that the country's allies in South East Asia would have to mount their own defences against military threats and it was realised that Australian forces were nearly wholly dependant on imports for defence equipment. By the 1990s self reliance was a part of Australia's defence policy. Israel which has been in a state of perpetual military tension and war since its declaration in 1948 has experienced a sequence of arms embargoes at times of extreme national crisis. The Israeli government pursued a policy of self reliance as necessary to the survival of Israel and to free Israel from political pressure from the supplier countries. Since the 1950s the increasing technical progress in Japanese industry led to increased self reliance in aerospace and military production. The Japanese government was lobbied to support increased self-reliance by the powerful industrial groups in Japan and by the growing unease of USA in the 1980s and 90s in continuing the supply of military technology.
to Japan. The emerging nations of the ASEAN with the exception of Brunei sought increased self-reliance in selected areas of arms production.

**Regional power aspirations**

Regional power aspirations have not played an obvious role in setting up domestic arms production although escalating military expenditure and an associated arms race in South East Asia has resulted in ASEAN, Australia and other countries in the region being aware of the need to influence neighbouring nations to promote regional security and stability. Japan's powerful military force and extensive weapons arsenal, mostly produced in Japan, are a display of regional power and a measure of the force which could be unleashed against an aggressor. The display is discrete and apparent to military observers while at the same time the pacifist policies of the Japanese constitution are given prominence and recognition. Israel, surrounded by heavily armed hostile neighbours, has to be seen as militarily powerful and its arms industry forms a valuable contribution to its military power.

Israel has experienced the political pressure exerted by supplier nations, not only in the extreme cases of arms embargoes, but also in having to consider the foreign policies of supplier countries. Examples of this were evident when the USA Nixon administration imposed political pressure on Israel during the 1968 to 1970 War of Attrition between Egypt and Israel, and again in 1973 to 1975 when political pressure was applied by the USA on Israel to accept a ceasefire to the Yom Kippur War. Israel itself sought to apply political pressure on China in connection with the supply of Chinese ballistic missiles to Saudi Arabia, by agreeing to a series of joint military equipment developments based on Israeli technology.

**Cost implications**

Cost implications of self sufficiency have been of secondary consideration in the choice between domestic production or importing arms. In 1985 the Australian government provided funding to subsidise uncompetitive defence projects where imports would have provided cost saving in the short term, where defence contracts were considered strategically important and also where there were prospects of a
valuable export market. Japan bore the cost of 1.2 billion yen for indigenous production of the Type 90 Main Battle Tank (one of three types of tank in the inventory of the Japanese defence forces in the 1990s) which was three times higher than the cost of the USA equivalent, the M1A1 Abrams tank.

Offsets

The terms offered and negotiated under offset deals and the benefits accrued by the recipient countries vary widely. The ASEAN countries incorporate offset deals into procurement programmes as a matter of policy. The Australian government hoped that the introduction of offset deals in the 1970s on arms imports would provide benefit to Australian industry but the results in terms of quantity and content of offset work proved disappointing in terms of technology transfer or commercial gain.

Government policy

Government support is a strong feature of military industrial capability. Australian and Israeli defence policies are based on self-reliance and the governments have taken steps to maximise domestic arms production for their own forces requirements and also to promote arms exports to amortise costs over larger production runs. Government policy has strongly dictated the shaping of the defence industries in ASEAN. In Indonesia the government industrial policy is directed towards Dwi Fungsi or commercial/military dual function, whereby three quarters of a company's production capacity is allocated to civil production and one quarter to military production in peacetime but which ramps up to surge production at a time of crisis. The country's industrialisation programmes, including offsets and countertrade deals, have been focused by the government on the shipbuilding and aerospace industries. The Malaysian government has also linked defence and economic development, for example the 6th Malaysian Plan of 1991 to 1995 has linked military procurement to industrial offset programmes. Singapore has demonstrated high levels of government involvement in the development of the defence industry. In the 1960s and 70s the government provided substantial investment in shipyards and encouraged foreign investment in the Indonesian aerospace industry. Foreign companies were given financial incentives and tax breaks to set up manufacture and repair facilities in
Singapore. In the late 1970s the government initiated incentive schemes to promote investment in research and development. In Japan the main feature of government support to the arms industry has been the promotion of international co-operation in research and development and the arrangement of licensed production deals. Japanese industrialists have powerful lobby groups which bring influence to bear on government policy. The lobby groups proposed increased domestic share of defence procurement and the government five-year plan for 1991 to 1995 included plans aimed at reducing the reliance of Japanese industry on US sources. In Israel government involvement in the defence industry was important particularly in dealings and negotiations with USA. Military grants of approximately $1.8 billion annually from USA directly benefited Israeli industry for procurement, development and research programmes for aircraft, tanks, missiles and electronics systems.

Availability of capital and diversity of country's industrial base

The availability of capital and the presence of a diversified industrial base influence the ability to set up and retain a defence industry. Singapore and Japan, which have become highly industrialised nations with stable economies, have highly capable defence industries. The Philippines, Thailand and Vietnam with very limited industrialisation have very low levels of arms production. Brunei has a strong economy and with minimal military expenditure has no need for an arms industry. Australia has shown restraint in making capital available for arms production and has directed effort and funding to selected areas of arms production, for example to naval equipment in line with its defence policy.

11.2.3 Survey by questionnaire

Method

The third method used to test the hypothesis and to investigate the reasons and methods for countries setting up indigenous arms production was a survey by questionnaire. Questionnaires were sent to arms dealers, defence industrialists, military and government authorities in Australia, Japan, Israel and the Asean
countries and also to arms dealers in Europe and in USA. The questionnaire covered the motivation for setting up an arms industry, the characteristics which influence the ability of the country to do so and the strategies used to achieve a defence industrial base. The questionnaire asked for each of the aspects to be rated in importance and asked for comment on any other important issues relating to the reasons or methods for setting up arms production. The responses to the survey were analysed on a personal computer using commercially available mathematical software.

Result

The survey by questionnaire did not support the hypothesis that licensed production leads to indigenous production of arms. Instead the survey found that licensed production was one of the methods to establish an arms industry and by comparison the importance of methods employed to establish and maintain an arms industry in the countries studied were, in descending order of importance:

1. Building equipment through increasingly complex stages of manufacture for example by first setting up repair and maintenance facilities, then assembly and progressing to full design and manufacture.
2. Strategy of building increasingly complex equipment, for example starting with ammunition, vehicles, ships, weapons to highly complex systems such as fighter aircraft.
3. Use of joint ventures and licensed production.
4. Direct investment by European or US arms suppliers.
5. Building by copying designs.
6. Building by employing foreign experts.

The survey showed that all the countries examined gave highest ranking of importance to increasing the complexity of manufacturing operations and the types of equipment being built. Japan and Israel, both countries with advanced arms industries, ranked licensed production as of significantly lower importance than did Australia, ASEAN or the western arms dealers. The significance of this difference may be that Australia and ASEAN are striving to build up a technically advanced arms industry and are using licensed production to achieve advancement. Western
arms suppliers are letting licensing agreements to countries including emerging supplier nations in order to gain market share in those countries. In contrast, Japan and Israel had high levels of licensed production in the past when the defence industries were less mature. The country study reported that Japan had implemented a policy to reduce dependence on foreign technology in arms production.

Japan rated the other four methods, copying, employing foreign experts, licensed production and western investment, at significantly lower levels of importance than did the other countries. This probably results from Japan's technology lead particularly in dual use technologies and consequently a reduced need to develop existing skills. The world dealers and Israel gave higher ranking to the importance of copying equipment than did the other countries. It may be the case that world dealers are more willing to recognise close similarities between systems which have been imported and systems which have been later designed indigenously and resembling the imported models.

Motivation

The result of the survey indicated that the motivation to set up an arms industry is primarily strategic and secondly political and the economic aspects carry less importance. In the countries studied, the motivation is based on the following factors in descending order of importance:

1. Improved self reliance (strategic)
2. Ensured security of supply, e.g. against embargoes (strategic)
3. To upgrade skill in local labour (political)
4. To import technology (political)
5. Save hard currency by minimising imports (economic)
6. Potential earning of foreign exchange though export (economic)
7. Cost reduction (economic)
8. To influence customer nations (political)
9. Regional power aspirations (strategic)
10. Local arms race (strategic)
There was close correlation between the countries on the levels of importance of strategic motivation. Israel gave higher ranking than the other countries to the importance of a local arms race. It was pointed out by an Israeli arms supplier that Israel's indigenous defence industry provided the benefit of strategic surprise, in fielding previously unknown weapons at a time of crisis.

**Ability to set up an arms industry**

The factors influencing the ability to set up and maintain an arms industry in the countries studied were, in descending order of importance

1. The availability of capital
2. A diversified industrial base
3. The level of state involvement
4. Access to an export market

Both ASEAN and Israel ranked the level of state involvement highly in comparison to the other countries. This reflects the high level of state involvement in supporting and sustaining the arms industry in Israel and in the governments' efforts to nurture embryonic arms industries in ASEAN.

**11.3 VALIDATION INTERVIEWS**

Twenty-five military and defence industrial experts were approached to comment on the results of the studies. The twenty-five experts contacted were Lord Weinstock, Lord Prior, Sir Geoffrey Patti, Air Marshal Sir Donald Hall, Sir John Weston, Richard Evans, Iain Duncan-Smith, HRH Prince Muda Mohamed Bolkiah, John Barry Wilmshurst, Lord Cuckney, Arthur Walsh, Erith Davies, Sebastian de Ferranti, Nicholas Franks, Arthur Dyer, Sir Robert Easton, Graham Smart, Bryan Drake, Captain Garry Kennedy, David Richardson, Peter Clark, David Laraman, Col.Rick Brown, Jim Celephane and David Fowler.

Seven of the experts on weapons production and arms trade were able to respond with comments on the findings of the studies and why the tests gave the results
obtained. All three studies gave the same result that the value of indigenous production is not a result of the value of licensed production of arms and the experts were asked if the results met with their experience and understanding of arms production.

The experts consulted (Appendices 11.1 to 11.7) concluded that the results were reasonable and agreed with their own experience that joint ventures and licensed production were used to establish a domestic arms industry but the impetus for setting up and carrying out indigenous production came from strategic, political and economic motives and the socio-economic background of the particular country.
DISCUSSION OF RESULTS

The overall ranking in importance of the criteria in establishing an indigenous arms industry found in the study was:

<table>
<thead>
<tr>
<th>Rank</th>
<th>Strategic motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Improved self reliance</td>
</tr>
<tr>
<td>3</td>
<td>Ensured security of supply at time of crisis(against arms embargoes etc)</td>
</tr>
<tr>
<td>18</td>
<td>Regional power aspirations</td>
</tr>
<tr>
<td>19</td>
<td>Local arms race</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rank</th>
<th>Political motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>To import technology</td>
</tr>
<tr>
<td>8</td>
<td>To increase employment and upgrade level of skilled labour</td>
</tr>
<tr>
<td>16</td>
<td>To exert influence on customer nations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rank</th>
<th>Economic motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Cost reduction</td>
</tr>
<tr>
<td>11</td>
<td>To save hard currency</td>
</tr>
<tr>
<td>14</td>
<td>Potential for earning foreign exchange through export</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rank</th>
<th>Socio-economic criteria which influence the ability to set up arms industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Availability of capital</td>
</tr>
<tr>
<td>4</td>
<td>Diversified industrial base</td>
</tr>
<tr>
<td>6</td>
<td>Level of state involvement</td>
</tr>
<tr>
<td>12</td>
<td>Access to export markets</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rank</th>
<th>Methods to establish an arms industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Direct investment by US/Europe</td>
</tr>
<tr>
<td>9</td>
<td>Use of joint ventures and licensed production</td>
</tr>
<tr>
<td>17</td>
<td>Building by employing foreign experts</td>
</tr>
<tr>
<td>20</td>
<td>Building by copying equipment</td>
</tr>
<tr>
<td>5</td>
<td>Building through increasingly complex stages (maintenance, servicing, assembly and test, construction, design)</td>
</tr>
<tr>
<td>7</td>
<td>Strategy of increasing the complexity of the equipment being built (ammunition and artillery, land vehicles, aircraft, ships, missiles, submarines)</td>
</tr>
</tbody>
</table>

All the countries surveyed demonstrated the importance attributed to increased self reliance and ensured security of supply. One of the experts consulted (Appendix 11.2) pointed out that in areas where licensed production had been withheld, such as South Africa and Israel, operational, commercial and political pressure had led to
greater self reliance and new innovative technology.

There was general agreement between the countries about the methods of establishing a defence industry. There was emphasis on the importance of building up arms capability in starting with less complex procedures such as in-service maintenance and testing, and then progressing to more ambitious procedures such as assembly and test and finally manufacture and design. Similar emphasis was given to the importance of gradually increasing the complexity of the weapons or arms being built, starting for example with the relatively simple but high volume ammunition and artillery industry. This pattern was seen in the country studies where the relatively young arms industries of the ASEAN countries were setting up aircraft and naval maintenance and overhaul facilities and also in the findings of the literature survey which showed the general order in which indigenous arms production was set up: artillery, propeller driven aircraft, guided missiles, armoured vehicles, main battle tanks, jet aircraft, major surface warships, radar, helicopters and finally submarines.

There was agreement that copying equipment or employing foreign experts were not considered important. One Israeli arms supplier pointed out that his country had access to Israeli nationals working in arms industries throughout the world, that Jewish immigrants into Israel were highly skilled so there was no need to use foreign experts. Another Israeli arms supplier pointed out that Israel had a pool of highly trained ex-military personnel who had completed compulsory military service.

A result of the survey was that only the world's dealers and Australia considered that
joint ventures and licensed production were important methods of establishing an arms industry. One of the arms experts consulted (Appendix 11.2) pointed out that a) in many cases licensed production has been limited by withholding knowhow, source codes etc., thus reducing the capability to transfer to self reliance and b) licensed production does not inevitably lead to indigenous production because it is often the requirement of a sale but will not be "followed through". One of the experts consulted (Appendix 11.3) said there was no surprise that the values of licensed and indigenous production moved together because the licence arrangement would have been entered into to meet a short term need. One justified the other and in countries where budgets were tight, such demonstrations of success are important. After such demonstration of "success" the reporting of consequential indigenous production would be "lost" for all sorts of reasons. Defence experts consulted (Appendices 11.6 and 11.7) agreed with the result of the macroanalysis that the value of indigenous production is not a result of the value of licensed production and that political, strategic and economic factors significantly impact the level of indigenous arms production.

One arms consultant (Appendix 11.4) made the point that the use of joint ventures and licensed production have been used by countries at all levels of capability (not only newly emerging suppliers but also established supplier countries), citing examples of USA with the licensed production of the UK Harrier jet, the UK with nuclear capability, Iraq with Scud missiles, and Israel with an array of US systems.

Arms dealers stressed that a personal and powerful economic motivation for
importing and not manufacturing was the provision of generous commission in the form of consultancy fees. One dealer pointed out that a personal strategic motivation for not establishing an arms industry, particularly in unstable newly emerging nations is that it could lead to the creation of a politically powerful industrial leader, for example a minister of industry, (whose interests may not coincide with that of the established military leader). An unattributable source was quite emphatic that the reasons for arms procurement by whatever means were: firstly to stop the government from being overthrown, secondly to overthrow the government, thirdly to deliver a suitable amount of commission to the right set of people and fourthly to provide the means to attack or defend against an enemy nation. This forthright opinion reflects the view of Krause (1992) who reported that the three forces shaping the patterns of military innovation and production and the subsequent transfer of weapons and skill were wealth, power and war.

One of the arms experts consulted (Appendix 11.3) pointed out that in his experience political gain played a much bigger role than was acknowledged in the results of the study and any type of production generates employment, money and political power. His experience was that political advantage at an important time in the development of a country plus long term political advantage to be gained from arrangements were by far the most important driving forces in arms procurement. Another expert consulted (Appendix 11.2) expressed surprise at the result that economic motivation ranked so low and he pointed out that if responses had been obtained from finance ministers or finance directors then the ranking may well have been higher. One expert (Appendix 11.1) stressed the importance of the economic motivation in the
emerging nations in the Far East pursuing the growing arms markets of the Pacific
Rim countries.

11.4 CONCLUSIONS

The study has examined how the defence industry has addressed the reduced defence
budgets and how countries seeking to build domestic arms industries were
undertaking licensed production programmes. The study tested the hypothesis that
licensed production in the defence industry leads to indigenous production. The
hypothesis was tested using a macro analysis, four case studies and a survey and the
results were discussed in validation interviews with experts in arms manufacture and
markets. The results of the tests did not support the hypothesis. The panel of
experts found the results of the tests corresponded to their experience and
understanding of the arms industry and that the main impetus for setting up
indigenous arms production came from strategic, political and economic motives and
the socio-economic background of the country. If it were possible to extrapolate the
result into the future, then defence companies would feel confident that setting up
licensed production does not lead to import substitution by countries setting up
indigenous production.

11.5 FURTHER RESEARCH

The study carried out in this report examined the criteria in the setting up and
retaining an arms industry and did not support the hypothesis that licensed production
led to indigenous arms production. The finding of the study invites an area of
research in other business activities, for example research to test the hypothesis that licensed production in car manufacturing leads to countries setting up indigenous production.

The macro analysis described in Chapter 8 examined a set of financial data on the value of major weapon systems produced in each country. An alternative approach could be to test the hypothesis on a different set of data specifically for a major weapon system type such as helicopters, ships, aircraft or missiles. Another relationship suggested in the literature review was that arms embargoes led to the requirement for increased self sufficiency. The investigation as to whether embargoes cause the level of indigenous arms production to increase would support or fail to support an hypothesis that arms embargoes lead to indigenous production.

The literature review showed that the third world and the emerging nations have been equipped with arms to a large extent with the products of relatively few nations. In recent years attempts have been made to redress this imbalance by the introduction of offset agreements, technology transfer programmes and counter trade agreements, but an imbalance probably still exists.

Two separate factors are present. There has been a simple balance of payments deficit, quantifiable in cash terms. Also, there has been a capability imbalance in that exporters tend not to release equipment which represents their own state-of-the-art. These two measures of the imbalance provide an interesting and potentially fruitful area for investigation.
If consistent measures of the imbalance could be obtained, these may show that the gap between the exporting and importing countries' cash flows and capabilities has narrowed. This would seem to be the case generally in that an increasing number of countries will only enter into large equipment purchases if the supplier provides technology transfer arrangements. Technology transfer arrangements including licensed production act to reduce the measure of imbalance.

If, therefore, the financial and technology gap between exporting and importing regions is narrowing, then the equipment suppliers who are currently dominant can only protect their markets by acquiring overseas production capability. Such a trend would indicate that cash and production were moving to the buyer's countries and therefore the currently dominant sellers will see their global market share decline unless they manufacture in the emerging nations.

If on the other hand the gap were found to be constant or widening, then licensed production and technology transfers present no threat to an exporting company's market dominance. On the contrary, a widening trend would indicate that the market is in fact becoming increasingly dominated by those large exporting companies. Such companies can expect to grow by acquisition, merger and joint venture. Indeed, this has largely been the case in the predominantly internal markets of the US and Europe during the periods of post war growth.
A central question of importance to defence companies is:

Do companies maintain global market dominance by merger, acquisition and joint endeavour in their home markets and thereby continue to dominate the world market, or do they pursue the growth of overseas production capacity and thereby service those markets from the inside?

The question invites an area of further research: the relationship to be explored is that an increased level of domestic in-country production in the emerging nations results in the narrowing of the technology and financial gap between the established supplier countries and emerging nations. This may be the relationship in the markets from the Developed World into the Third World and the Emerging Nations.

The measurement of the technology gap, the financial gap and the level of domestic production over a period of time when the importing country has been engaged in domestic arms production will show whether the financial and technology gap has increased or narrowed. Similarly the value of domestic arms production could be measured over the same period. If the result shows that the financial and technology gaps have narrowed while the levels of domestic production have increased, then the existence of the relationships would be supported. If it is the case that the financial and technology gaps have remained stable or have decreased, or that the level of domestic production has not increased, then the relationships would be in doubt.
The relationships to be explored could be expressed mathematically as:

\[ T_{\text{Technology Gap}} = f_1 (D_{\text{Domestic production}}) \]

\[ F_{\text{Financial Gap}} = f_2 (D_{\text{Domestic production}}) \]

The variable \( T_{\text{Technology Gap}} \) is a measure in years and quantifies the difference in age of the design of a military system, e.g. helicopter or a fighter aircraft in use in the importing country relative to the exporting country. An example of a decreasing technology gap is seen in Japan, where in the mid 1970s Japan was using aircraft designed in USA in the 1950s (= 20 year gap) and in the 1990s Japan is building aircraft with the USA (= 5 year gap). Published data banks are available on the military systems of virtually all the countries of the world and on each category of military system: fixed wing bombers, fighter aircraft, attack helicopters, etc. A judgement can be made on the age of the system in use from design completion date to the first import date by the importing country.

The unit to be measured for the \( F_{\text{Financial Gap}} \) variable is the ratio of arms imports to arms exports in the trading countries over a chosen timescale during which offset arrangements have been implemented. A high value in the ratio of arms import to arms export indicates a high financial gap between the importing country being examined and the exporting nation. Data banks are readily accessible on the world trade in arms. Publications listing arms and military trade figures for virtually all countries include those by SIPRI, USA Congressional Research Service, US Arms Control and Disarmament Agency.
Chapter 11

The Domestic production variable is a measure, valued in constant year US$, of the value of domestic arms production in the importing country.

A second and parallel relationship to be explored is that the exporting nations providing high technology weapons in a decreasing market results in the market becoming dominated by fewer larger companies which grow by acquisition and merger. It is proposed that the size of the world's major defence companies in terms of defence business turnover and values of acquisition and mergers could be measured over periods of increasing, stable and declining military expenditure. The relationships to be explored could be expressed mathematically as:

\[ N_{\text{Number of major companies}} = g_1(D_{\text{Defence market size}}) \]
\[ M_{\text{Number of mergers and acquisitions}} = g_2(Q_{\text{Change in Market size}}) \]

The variable \( N_{\text{Number of major companies}} \) is a measure of the number of major defence companies over a specified size (measured in constant year US$ turnover in defence business) and can be measured over a period when the defence market has been increasing, steady and in decline. Data is published on the top 50 and top 100 defence companies.

The variable \( M_{\text{Number of mergers and acquisitions}} \) is the number of mergers and acquisitions of defence businesses could be found by data search in company records and published surveys.
The variables $D_{\text{Defence market size}}$ and $C_{\text{Change in market size}}$ are a measure of the size of the defence market measured in constant year US$ and the change in market size is measured as a percentage change per annum in the defence market size. Published databases provide records of the sizes of defence markets.

To investigate the hypothesis the model could be based on the observed data by using best fit modelling which correlates observed data with the generalised equations

\[
T_{\text{Technology Gap}} = f_1 (D_{\text{Domestic production}}) \\
F_{\text{Financial Gap}} = f_2 (D_{\text{Domestic production}})
\]

relating the technology gap, the financial gap with domestic production, and

\[
N_{\text{Number of major companies}} = g_1 (D_{\text{Defence market size}}) \\
M_{\text{Number of mergers and acquisitions}} = g_2 (C_{\text{Change in Market size}})
\]

relating the numbers and sizes of defence companies and the numbers of mergers and acquisitions to the market size and to the rate of decline in the market. In order to determine the functions $f_1, f_2, g_1, g_2$, the data could be tried against a range of models such as linear, polynomial, logarithmic, exponential etc. in order to identify that which provides the best fit, as measured by a figure of merit called "the goodness of fit" (Mathsoft Inc., 1993).
11.6 SUMMARY

In the 1990s military threats have become more sophisticated but defence budgets have been reduced. There is a political preference for diplomatic and economic sanctions rather than direct military intervention. This study has examined an area of change in the nature of the defence markets and their effects on the arms industry. The investigation did not support the hypothesis that licensed production results in indigenous arms production in the countries studied, but instead showed that both types are the result of political, strategic and economic motives. The arms market is substantial and many nations believe a modern defence industry is necessary for a credible military capability. Both industry and governments should seek to benefit mankind from the opportunities presented by today's political order.
Chapter 12

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ANNEX 8.3

Calculation of correlation coefficients between indigenous and licensed arms production for Argentina
Annex 8.3: Calculation of correlation coefficients between indigenous and licensed arms production for Argentina

\[ xx := \text{READPRN(argentina)} \]

\[ D := xx' \]

\[ \text{length}(D_{\times p}) = 26 \]

\[ \text{length}(xx_{\times p}) = 4 \]

\[ n := 0..25 \]

\[ m := 0..3 \]

\[ A_m := \frac{1}{26} \sum_n D_{n,m} \quad \text{average of each row} \]

\[ E_{n,m} := D_{n,m} - A_m \quad \text{take away average of each row} \]

\[ E0 := E^{\times p} E1 := E^{d,p} E2 := E^{d+p} E3 := E^{d+p} \]

Make sure that MathCad does not try to evaluate array using a negative index.

\[ f0(p,q) := \text{if } (p \geq q, E0_{p,0}) f1(p) := \text{if } (p \geq 0, E1_{p,0}) \]

\[ f2(p) := \text{if } (p \geq 0, E2_{p,0}) f3(p) := \text{if } (p \geq 0, E3_{p,0}) \]

correlation coefficients

\[ p := 0..7 \]

average of E0 from p to 26

\[ B0_p := \frac{1}{26-p} \sum_n f0(n,p) \]
average of \( E_1 \) from 0 to 26-\( p \)

\[
B_{1_p} := \frac{1}{26-p} \sum_n f_1(n-p)
\]

same with \( E_2 \) and \( E_3 \)

\[
B_{2_p} := \frac{1}{26-p} \sum_n f_2(n-p) \quad B_{3_p} := \frac{1}{26-p} \sum_n f_3(n-p)
\]

Numerator of correlation coefficient

\[
X_{0_p} := \frac{1}{25-p} \sum_n (E_{0_n} - B_{0_p})^2 \quad 1/(N-1) \text{ times sum of squares}
\]

\[
Y_{0_p} := \frac{1}{25-p} \sum_n (f_1(n-p) - B_{1_p})^2 \quad 1/(N-1) \text{ times sum of squares}
\]

\[
C_{0_p} := \frac{1}{25-p} \sum_n (E_{0_n} - B_{0_p})(f_1(n-p) - B_{1_p}) \sqrt{X_{0_p}Y_{0_p}}
\]

\[
C0^T = [0.941 \ 0.325 \ 0.223 \ 0.174 \ 0.291 \ 0.13 \ -0.079 \ -0.219]
\]

\( E_0 \) and \( E_1 \) of the same year show a 94.1% correlation - very high

\[
Y_{0_p} := \frac{1}{25-p} \sum_n (f_2(n-p) - B_{2_p})^2
\]
$C_{1_p} := \frac{1}{25-p} \sum_n (E_0_n - \hat{B}_0_p)(f^2(n-p) - B^2_p) \sqrt{X_0_p Y_0_p}$

$C_{1_p}^T = (0.334 \ 0.338 \ 0.522 \ 0.4 \ 0.289 \ -0.04 \ 0.094 \ 0.307)$

E0 and E2 of two years back show a 52.2% correlation - highish

$Y_0_p := \frac{1}{25-p} \sum_n (f_3(n-p) - \hat{B}_3_p)^2$

$C_{2_p} := \frac{1}{25-p} \sum_n (E_0_n - \hat{B}_0_p)(f_3(n-p) - \hat{B}_3_p) \sqrt{X_0_p Y_0_p}$

$C_{2_p}^T = (0.767 \ 0.428 \ 0.511 \ 0.438 \ 0.368 \ 0.061 \ 0.043 \ 0.114)$

highest correlation of sum of E0, E1 and E2 with E0 is in the same year

$q := 0.23$

$G_q := E_{0,q} F_q := E_{2,q+2}$

$q := 0.25$
ANNEX 10.1

THE QUESTIONNAIRE FORM
Appendices

Contents of the Questionnaire

The questionnaire asks you to categorise the importance of various aspects of countries setting up indigenous production. The countries include Asean, Israel, Australia and Japan.

1. Motivation to establish an arms industry

1.1 Strategic
    Improved self reliance
    Ensured security of supply, e.g. against embargoes
    Regional power aspirations
    Local arms race
    Other

1.2 Political
    To import technology
    To upgrade skill in local labour
    To influence customer nations

1.3 Economic
    Cost reduction
    Save hard currency by minimising imports
    Potential earning of foreign exchange through export

2. What influences or determines the ability to establish an arms industry?
    Availability of capitals
    Diversified industrial base
    Level of state involvement e.g. government ownership or support.
    Access to export markets
    Other
3. Methods to establish defence industry
   Direct investment by USA, Europe etc.
   Joint ventures and licensed production
   Employment of foreign defence experts.
   Copying equipment
   Gradual increase of complexity, e.g. first servicing, then assembly, and production
   Gradual increase in complexity of types of equipment, e.g. first small arms, then missiles, tanks, jet aircraft, etc.
   Other
QUESTIONNAIRE

DEFENCE PRODUCTION IN COUNTRY

Please categorise the importance of each item in the setting up of indigenous defence production in the country, and add any comments on issues you believe relevant.

1. MOTIVATION TO ESTABLISH AN ARMS INDUSTRY

1.1 STRATEGIC MOTIVATION TO ESTABLISH AN ARMS INDUSTRY

A. Improved self reliance.
   Please tick one box

B. Ensured security of supply.
   Please tick one box

C. Regional power aspirations.
   Please tick one box

D. Local arms race.
   Please tick one box

E. Please comment on any other STRATEGIC motivation to establish or not to establish an arms industry in a country.
### 1.2 POLITICAL MOTIVATION TO ESTABLISH AN ARMS INDUSTRY

<table>
<thead>
<tr>
<th>Motivation</th>
<th>Extremely important</th>
<th>Not important</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. To import technology.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Please tick one box</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. To upgrade skill in local labour.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Please tick one box</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. To influence customer nations.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Please tick one box</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. Please specify and comment on any other POLITICAL motivation to</td>
<td></td>
<td></td>
</tr>
<tr>
<td>establish or not to establish an arms industry.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1.3 ECONOMIC MOTIVATION TO ESTABLISH AN ARMS INDUSTRY

A. Cost reduction.  
Please tick one box  
Extremely important  
Not important  

B. Save hard currency by minimising imports of defence equipment.  
Please tick one box  
Extremely important  
Not important  

C. Potential earning of foreign exchange through export.  
Please tick one box  
Extremely important  
Not important  

D. Please specify and comment on any other ECONOMIC motivation to establish or not to establish an arms industry.
2. WHAT INFLUENCES/DETERMINES THE ABILITY TO ESTABLISH AN ARMS INDUSTRY

A. Availability of capital to establish a technology-intensive defence industry (e.g. for manufacturing facilities, R&D, imports, domestic defence procurement budget).

□ □ □ □ □

Please tick one box

Extremely important
Not important

B. A diversified industrial base (e.g. aerospace, metallurgy, machinery, electronics) has been:

□ □ □ □ □

Please tick one box

Extremely important
Not important

C. The level of state involvement (e.g. direct ownership to ensure viability or government provides fiscal and trade incentives) has been:

□ □ □ □ □

Please tick one box

Extremely important
Not important

D. Access to export markets to ensure viability of domestic defence industry has been:

□ □ □ □ □

Please tick one box

Extremely important
Not important

E. Please specify and comment on any other issues relating to the country's ability or inability to establish an arms industry.
3. METHODS OF ESTABLISHING A DEFENCE INDUSTRY

A. The use of direct investment by European, USA or other countries' defence industries has been:

Please tick one box

<table>
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B. The use of joint ventures and licensed production has been:

Please tick one box

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</table>

C. Building an industrial defence capability through employing foreign defence experts has been:

Please tick one box

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</table>

D. Building an industrial defence capability through copying equipment which has been obtained from other countries has been:

Please tick one box

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</table>

E. Building industrial defence capability through increasingly complex stages (e.g. assembly and test, expert procurement and specification of systems, system design, build, but retaining purchase of more complex items such as avionics) has been:

Please tick one box

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</table>

F. The strategy of increasing the complexity of the type of defence equipment being built (e.g. types in increasing complexity: artillery, propeller aircraft, missiles, tanks and armoured vehicles, jet aircraft, ships, radar, helicopters, submarines) has been:

Please tick one box

<table>
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<tr>
<th>Extremely</th>
<th>Not</th>
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</tbody>
</table>

G. Would you explain any other methods the country has or could have used to establish an arms industry.
MATERIAL REDACTED AT REQUEST OF UNIVERSITY