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South Africa:
The Arms Embargo and National
Controls

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The arms embargo and national controls

1. Introduction

Two recent news reports indicate the significance of the problem to significantly implement the arms embargo against South Africa. South African Defence Minister Magnus Malan has given in March 1986 (JANE'S DEFENCE WEEKLY, 15 March, p. 454) figures for what he perceives as the "threat" to South Africa. Over the past six years, the number of tanks facing South Africa reportedly has increased by plus 30 %, the number of fighter aircraft by plus 270 %, and the number of helicopters by plus 400 %. According to Mr. Malan, South Africa must increase her military effort.

The second bit of information is how the present South African regime is going to counter such perceived developments. With respect to equipment for the ground forces and the police, South Africa is said to be self-sufficient. The level of the self-sufficiency is indicated e.g. by the information about three new AFVs (armoured fighting vehicles) developed by Sandock-Austral Ltd., labelled AC 100, AC 200 and Ingwe. The journal quoted above (JANE's DEFENCE Weekly, 26 April 1986, p.754) reports:

"Wherever possible, proven commercially available components, such as the engine, transmission and axles have been used to keep life cycle and procurement costs to a minimum".

In other words, the V-8 turbocharged diesel for those vehicles and other key components are freely bought on world markets, and incorporated into vehicles such as Ingwe which is designed for

"patrolling high risk areas such as airports and power stations." Diesel engines are said to be of a truly innocent nature, and not suitable for embargos. But the V-8 turbocharged variety, with its enormous horse power (430 hp in the case of the AC 100, 370 hp in the case of the AC 200, and still 166 hp for the Ingwe) would alarm customs officers if somebody would try to transfer them from the West to the Soviet Union or a socialist country, because such high performance engines are normally not used in civil application.

The information given leads to two important questions. Both are decisive for the policy of a comprehensive arms embargo. First, the claim to have achieved self-sufficiency needs to be scrutinized (section 2). If South Africa would indeed have managed to reach autarky in military procurement, then the embargo would be frustrated. Second, the claim that the South African military build-up is directed against the threat of external aggression needs to be assessed (section 3). If the weapons developed indigenously in South Africa are primarily of use against the black majority, then the claim made e.g. by Mr. Malan can be verified as propaganda.

The actual test required to answer both questions is of a highly technical nature. In this paper, we will use the much-trumpeted G-5 155 mm howitzer to assess the current level of self-sufficiency in South African arms making. The answer to the second question requires a sector-by-sector approach, which will be envisaged throughout this paper.

The ambiguity of the origin of technological components (question 1) as well as the ambiguity of purpose are much more apparent with the key sector of the embargo, aeronautical equipment. South Africa claims to have filled the most obvious gap in equipment by turning out an indigenously designed attack helicopter, the Alpha-XH1 aircraft. The claim is that the aircraft "has been developed from scratch and makes greater use than ever before of locally developed components, having a completely locally developed airframe" (JANE'S DEFENCE WEEKLY, 22 March 86, p. 511). Technical journals describe this recent aircraft as "based on the Alouette III" (INTERNATIONAL DEFENCE REVIEW, No. 4/1986, p. 40), a French helicopter extensively used

by South Africa. By means of "add-on engineering", the Armscor technicians added a nose section to the French helicopter which reflects the typical design features of an attack aircraft, including welded steel tubing for the centre section. Beyond combat helicopters, the requirements of the present South African regime are mounting with respect to the principal weapon of the air force, a fighter/ground support aircraft. Apparently the remaining six (only six) Buccaneer S-50 aircraft played a strategic role; a military journal (JANE' DEFENCE WEEKLY, same issue, p.767) reports that "the Buccaneers have seen action in most of the major cross-border strikes where their special capabilities have proved very useful". This information points at two interpretations: firstly, the embargo for bomber-type aircraft such as the Buccaneer apparently is effective. Bomber aircraft can't be procured by South Africa, hence the reorientation towards components instead of complete weapons. Second, military equipment which was officially said to have no significance for internal unrest is used to fill up the gaps. The report just cited maintains that because the lack of Buccaneers French Mirage F-1 AZs are used in a supplementary role: "The small size of this force (referring to the Buccaneers, U.A.) does place a burden on the Mirage F-1 AZs as they have to handle many tasks that would be better suited to the Buccaneers if there were more of them."

The message from this quote is that military equipment which was labelled as not directed for internal repression will be used by the present regime in a supplementary or surrogate role, and that hence the arms embargo against South Africa should be comprehensive, including all military equipment, also the one which is said for external defence purposes only.

The present state of defence preparedness of South Africa strongly hints that the white minority of 4.6 million is defending the country against the black majority (15.2 million, plus 2.8 million coloured people, 0.8 million Asians, and 5.5 millions in the homelands), and not against any external threat. Thus, the 250 old Centurion tanks (South African name: Olifant) may be suited for external defence. But these main battle tanks are rivalled by 1.600 Eland, 1.500 Ratel plus 1.500 armoured cars of other types (Buffalo, Hippo, Rhino, Lynx). The rate of 250

main battle tanks as confronted with 4.600 armoured cars is quite unique in global comparison. The West German standard is one tank per one armoured car, and this is internationally a high share of ACs.

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The odd relationship, that 250 heavy tanks are off-set by 4.600 vehicles for purposes of internal repression is again reflected, if one looks at airforce equipment. Essentially, the South African air force consists of 82 Impala counter insurgency aircraft, plus 145 helicopters of French design. The force of modern supersonic combat aircraft appears as diminutive in comparison: 20 Mirage III CZ/EZ and 32 Mirage F-1 AZ/CZ, plus less than a dozen bomber aircraft of British origin. This comparison is neglecting forces of Training Command and Attack/Training Units, where a similar relationship would emerge. And because also the supersonic Mirage aircraft are used in the ground attack role, it becomes convincingly clear that the South African airforce is predominantly a force to control the majority of the population within the country. There are no excuses for exporting countries, that military equipment delivered to South Africa potentially could only serve to fight external threats.

2. National "self-sufficiency" in arms making

Representatives of the present SA regime have maintained repeatedly that the country is by now self-sufficient in arms manufacturing. This claim needs to be scrutinized on several counts. First, the SA Government is likely to boast more in capabilities than it may have available, as a measure of disinformation. Second (and politically more important), the SA Government may overrate current accomplishments by viewing them as a definite step towards autarky. In the manufacture of sophisticated weapons systems, however, self-sufficiency is not a fixed threshold which can be crossed once for all. For secondary producers such as SA, "self-sufficiency" is rather a highly time-sensitive concept which is tied to a specific level of technology. Third, the answer to the question about SA self-sufficiency poses important conclusions for other Governments

about the arms embargo. The understanding of this crucial issue requires additional reasoning.

On the level of Governments of nations states, "self-sufficiency" is accomplished if weapons can be procured which are made by enterprises under the political control of the respective Government. It does not matter whether those firms are purely indigenous by nature or whether they represent foreign competence in the form of a filial of multinational enterprises. The contribution of "foreign" firms in a national strife for self-sufficiency traditionally has been overlooked by proponents of autarky policies. - South Africa, as any semi-industrialized country, is characterized by an extreme role of such "foreign" actors in the economy, be it arms or other products of manufacturing. Hence the political claim by the Government of self-sufficiency should be understood from the start in a specific context: that the regime is commanding resources under its jurisdiction which are not necessarily of an indigenous nature. From the point of view of applicability of embargoes, the definition of "self-sufficiency" will vary, especially in the case of countries such as SA. National Governments of other states could act to control the flow of technologies across their national borders both with respect to other Governments as recipients as well as non-Governments (intra-company trade or commercial trade among private companies). A full denial of technology transfers implies a more active role of the Government of a delivering state than the traditional understanding of embargo implies.

Thus the traditional meaning of autarky, or self-sufficiency, that the country/state can turn out everything required for reproduction, including national defense, is eroded by the incongruence between political and economic systems. This incongruence - speaking in abstract terms - may enable a Government to pursue policies independent from other Governments, but dependent from the cooperation of the international economic system. Under normal circumstances, this split has no particular meaning, because the political objectives of a number of Governments and the economic policies of the economic sector are more or less in line with each other. A Government in disagreement with the majority of other State Governments may opt

to play the role of a "free rider" in the economic sphere, and this is perfectly what the present SA Government aims to accomplish. The "free rider" may use the advantages of the international economic system, e.g. for provisions of national defence, without adhering to the consensus about political objectives which characterises the community of Governments at large.

The claim of self-sufficiency challenges the increasing tendency of economic cooperation among States. Nazi Germany provides for the most significant claim in this respect. By now it is established that even under the technological conditions of the 'thirties, Germany remained highly dependent from inflows of foreign technology, contrary to the claims by the Government. It can be assumed that the SA Government with its much feeblar industrial base is facing a comparable contradiction.

The Nazis tried to accomplish self-sufficiency by resort to serious reductions of imports, and resort to surrogate products which should compensate for imported goods. Even the rigorous Nazi effort to achieve self-sufficiency, at much more moderate levels of technology, was frustrated by the interconnected nature of the economy and the world division of labour. Hence it can be concluded that there remains a small chance from the beginning for countries such as SA to become self-sufficient, even if it were for just one sector, arms making.

The "arms industry", however, is an ambiguous entity within any economy. A closer view reveals that it remains hard to isolate the manufacture of weapons system from industry in general. Manufacturing technologies, design know-how, technologies of components are widely farmed out in the economy. Differentiation and depth of industrial as well as infrastructure mark important features for the success of the indigenisation of arms production, as it is well known from case studies in a number of semi-industrialised countries. On these counts, SA has achieved a medium level or less.

The claim of self-sufficiency encompasses a number of inputs into a production effort: physical ones such as raw materials, machinery, components, qualified labour, and capital, as well as

immaterial ones, such as know-how, abilities in manufacturing and design, etc. It will remain hard to assess from the outside to which extent SA is able to command all of these inputs. The following analysis remains limited to a selection of material inputs. As it will be demonstrated, the claim for self-sufficiency can be falsified in this limited segment of the total of inputs. It can be assumed that the level of sufficiency is much more limited with regard to immaterial inputs than it is found for the material inputs.

The immaterial inputs are not subject to Government-to-Government transfers (or embargoes), they remain within the arcanum of private multinational companies. As will be shown, also the lion's share of other inputs, notably components, reaches SA via intra-company transfer links. In order to implement the embargo, Governments must learn to deal more effectively with such transfer links.

3. Actual "sufficiency": The case of the G5 155 mm howitzer

The G5 howitzer repeatedly served as a demonstration of South Africa's ability to indigenously design and produce sophisticated military items. In 1982, a pre-series copy of the G5 was on exhibit at the "Defendory" arms fair at Piraeus in Greece. This provided for an extraordinary chance to check the howitzer and components with a view to the claim of SA self-sufficiency.

In order to execute such a check, one needs to go into considerable technical detail. In a second step, findings of a technical nature will be interpreted in a political manner. The main finding will be that the G5 howitzer represents a mixed bag of foreign component technologies rather than a truly South African effort. Presently, it is only possible to indicate with reference to hardware components where there is evidence of South African adaption of foreign technology. Whether this technology was stolen, commercially acquired, copied or transferred by other ways cannot be stated with comparable certainty. The impression is that SA used various ways to collect component technology for the G-5 howitzer.

The best known feature of the G-5 is a certain commonality of design features with the Austrian GHN-45 gun. Because the Austrian gun is in the lead in its development cycle by a margin of two years, it can be assumed that South African designers strongly looked at the Austrian howitzer development. There are confirmed reports "about Austrian engineers having participated in the development and production of South Africa's G-5 howitzer. In both cases, there has been official confirmation" (see B. 1, The arms embargo and Austrian controls, annex 2, 11). The relationship between the two guns development processes can be read in the fact that the Austrians by now copy a novel design feature of the G-5, an air-cooled auxiliary diesel engine with 51 h.p.

The enormous range of the howitzer of up to 37,5 km is based on the so-called "Base-Bleed-Technology" for the ammunition. This technological innovation was developed and patented in Sweden. Outside Sweden, the Belgian PRB-Group holds world rights for this technology. The SA shells and especially the ignition section show (IDJ 12/82, p. 1731) "striking similarity with those of the Belgian firm PRB". The significance of this "Base-Bleed-Technology" can be read from recent experience of fighting in Angola. In 1975, the SA troops found themselves, as Armscor chairman Commandant Piet Marais put it, "being outgunned by quite a few Russian weapons". In mid-1981, the G-5 was firstly used to retaliate in Angola.

The "Base-Bleed-Technology" appears as too demanding in technology that a company with limited experience in this field such as Armscor could simply steal it. The plant for the filling of 155 mm grenades with the exotic explosive was clandestinely acquired from the German firm Rheinmetall via Paraguay. The responsible managers of the firm were sentenced in the end of May 1986 by a German court (the first incident of a verdict because of illegal arms exports in this country). In conclusion, there remain questions to be answered about the acquisition of "Base-Bleed-Technology" by South Africa.

The general lay-out of the 155 mm-gun is based on development work by the US firm of Space Research (see repeated presentations by Abdul Minty). A number of additional components of the G-5

give reasons to question the origin of their technology. Photos of the gun reveal that muzzle velocities are measured by a separate doppler radar set labelled EWVA Mk. 10 B, a non SA-item. It remains strange that the South African press, e.g. the Sunday Express, Johannesburg (17 Oct. 1982) highlight the muzzle velocity analyser as a genuine Armscor success. The design of the breech of the howitzer "shows a strange comparability to the one of the American M-109" (same source), what also applies to the jacks of the recoil compensation hydraulics. For some of the grenades of the G-5, US ignition systems of the type M 572 are in use. Besides US-technology, Israeli components are discernible. The Israelian "David" fire direction system is found to be "noticeably similar" to the piece of equipment used for this purpose on the SA gun. In this instance, it can reasonably be concluded that the fire direction equipment was secretly but officially transferred from Israel. - Parts of the gear for gun elevation reportedly came from the UK (Evening Telegraph, 9 July 1985, see A.5).

In sum, G-5 combines American, Austrian, Swedish/Belgian, Canadian, West German, British and Israeli technologies. While a number of components show signs of "add-on engineering" to the original foreign product, the whole howitzer is the least of all possibilities a SA design. Also this prominent example of SA technological competence illustrates a heavy reliance upon foreign components. This dependency potentially opens additional possibilities to improve the arms embargo.

4. The problem

UN resolution 418 is very clear about "arms and related material" as well as plants and other resources for the manufacture of arms. It can be stated by now that the South African regime is unable to obtain military end products, i.e. goods obviously destined for military purposes, on world markets. In the last 20 years, since the time of the voluntary arms embargo of 1963, and especially after the mandatory arms embargo of 1977, South Africa embarked upon major licensing programs (see following table). The start of the Impala license production program exactly 20 years ago, and the much more demanding manufacture of Mirage F-1 aircraft in the beginning of the 70s provided the country with

sophisticated equipment, and established a source of potentially uninterrupted supply. Also 20 years ago, the license manufacture of French armoured cars started.

It appears by now, that it would be futile to debate the granting of licenses for weapons manufacture to South Africa, because most of the contracts date from the time before the mandatory embargo. Beyond the transfer of military end products, also the licensing of the manufacture of military equipment apparently comes to a halt, if the SIPRI statistics hold. It remains important to insist on the embargo for weapons, and means to manufacture them. But because of the success of these two steps, presently the root of the problem rests in a third area, components.

In order to illustrate this third problem area, a basic comment about the technological nature and the institutional arrangements in the manufacture of sophisticated modern weapons will be in order.

Major weapons systems consist of tenth of thousands of parts. In the case of modern battle tanks the individual elements which lead in the end to the fighting vehicle number tenth of thousands; in the case of combat aircraft they number more than 100.000. No military producer manufactures himself all of these items. To the contrary, the manufacturing of modern weapons can be seen as the concerted effort to integrate a vast majority of sub-contractors. In the case of the German Leopard tank, 2.700 firms manufacture parts, which are integrated into components, which 450 firms deliver to the end-producer, in this instance Krauss-Maffei. There is no exception to the rule that any major weapons system is composed of a multitude of components made by various manufacturers, numbering the hundreds and thousands. Due to the less differentiated industrial base in developing countries and also in South Africa, numbers may be smaller in a Third World context.

For the South African authorities, the conclusion remains, after the negation of the import of complete weapon systems, and the apparent ending of the possibility to sub-contract per license for the manufacture of sophisticated systems, to do it alone, and to shop for the parts and components of a major weapons system on

the world market. Parts which cannot be obtained must be produced in South Africa - or must be shipped. The integration of thousands of semi-products into a weapon system certainly requires enormous competence in systems engineering and integration. As the table shows, South Africa is currently able to mobilize the respective resources abroad to get this kind of support. On the other hand, engineering support in systems engineering hardly will be considered to fall under the embargo. This points at a first loophole, which ought to be closed in order to make the arms embargo truly effective.

A premature conclusion on the supplying end, involving both governments and industry, could read that given the differentiation of the arms industry and the producers of individual components, that there is hardly any way to control transfers, let alone transfers of an eclectic manner to South Africa.

I submit that such a conclusion is utterly wrong. On a technological level, the tenth of thousands or even hundred of thousands of military items are in general not congruent with comparable items traded on commercial markets for civilian purposes. Military specifications call for specific characteristics of those items, normally labelled by such language as "heavy duty", resistance against radioactivity, or the like. Custom officials potentially could be alarmed by such descriptions.

The more important feature is that institutionally military specifications shape the manufacture of parts and components in a special manner. In contrast to commercial markets, national security specifications separate the manufacture even of such general products as bearings or bolts for military customers from the general supply of such common items, and the state authorities have potentially any opportunity to assure the control of manufacturing and exporting.

Presently, the problem of endorsement of the mandatory arms embargo rests with the problem of handling the transfer of components and technological know how. The sale of military end use items as well as the granting of licenses are clearly covered

by the UN resolution 418. The termination of earlier accords, the supply of spares and the delivery of para-military equipment still are open to interpretation. Problems manifest in those areas cumulate, however, because each member state unilaterally interpretes the terms of the embargo itself. A number of states have different regulations. Partly, the problem may be explained by the fact that a state bureaucracy has got to adopt to technological issues. This was easier to manage with respect to end items such as complete weapons systems, e.g. fighter aircraft, tanks etc. International agreements about licensing also are better accessible to national controls than are components and semi-fabricated products. The difficulties for state authorities, partly also the unwillingness to subscribe to the UN embargo, resulted in a weak embargo.

The main conclusion, if one inspects the adherence to the UN embargo by member states, remains that political will to engage according to the thrust of UN resolution 418 provides for the decisive line of developments. It is not so much the absolute power of state authorities to exert efficient control, but the prescriptive role of state policies to industry, to go to South Africa or not, which assures the effectiveness of embargo policies. In my subjective view, a number of member governments of the United Nations pay attention to the embargo, but seek also possibilities to alleviate exports by companies based in their countries because of pressing economic interests. State authorities in a number of individual transfer cases could have known, if they would have been willing to do so, in the case of fraudulent transfers. A point in case is provided by the sale of a munition filling plant to Paraguay. The German authorities could (and perhaps should) have known that Paraguay was not a likely end user for such equipment. Suspicions about the end user certificate could have led to the assumption that embargoed recipients, such as South Africa, would in the end procure the doubtful item. The excuse of the German Government, that compartmental incompetence gives the explanation for the wrong assessment of the real destination of the munition filling plant remains not very convincing.

A striking example of the significance of political will in implementing the mandatory arms embargo is given by France.

Apparently, the French government decided to include the Mirage license deal under the embargo provisions. This decision proved to be enormously effective, within a short time span. The South Africans were unable to continue the project to produce the Mirage F-1, which had started in 1972. According to Brzoska and Ohlson, "work was confined to part production, overhaul and maintenance" ("Arms Production in the Third World", page 200). By comparison, the conduct of the Italian government is not so clear. The Impala 2 COIN aircraft, basically still an Aermacchi MB-326K, a major example of the South African strategy of "add-on-engineering", is claimed to be a purely South African effort. There remain doubts, however, about the possible cooperation of the Italian source of technology, looking at the different wing and other improvements of design features.

The Italian example points to a specific "grey area", where apparently South Africa was able to secure foreign technology for the military sector in the recent years. The South African branches of multinational cooperations apparently were in a position to degrade decisions by national governments in Western countries about the implementation of the embargo, and continue the cooperation with South African firms on a commercial basis. If this holds, then a second large problem area for the future implementation of the embargo should be noted, alongside the emerging pre-eminence of dealing with components of weapons systems: the behaviour of non-state actors, multinational firms.

The two problem areas interact, especially in case of dual-purpose items which can be used both for civilian and military purposes. The delivery of diesel engine technology by firms such as Perkins (UK) and Daimler Benz (FRG) evades the attention of state authorities, because of the interpretation of the embargo as basically referring to end-products of a lethal nature only, and - what makes work of customs authorities even harder - intra-firm transfers within a multinational company provide an additional shield against the detection of such transfers.

On the side of governments, a basic development comes to bear, which ought to be mentioned. While the rethoric of Western governments about principles of their arms export in the past was dominated by language about non-proliferation to "areas of

conflict" (and South Africa would fall into this category), more recently, in an era of protracted economic problems in industrial countries, semantics have shifted in such texts to the pursuit of the "national interest", or even "vital interests". A significant example is provided by the government of the FRG, which re-defined its arms export policy in this respect in 1982. The resort to the "national interest" instead of the prohibition to deliver arms into "areas of tension" certainly will not be helpful to restrict arms transfers to South Africa.

5. The embargo reinforced by a COCOM system?

It has been repeatedly suggested, especially by the World Campaign against military and nuclear collaboration with South Africa, to extend the COCOM system of embargo of military items destined to block the transfer of military goods to socialist countries to South Africa. The COCOM system certainly can be used as an example, in order to study the existing machinery, the lists of strategic and other military items as defined there, in order to assess the effectiveness of this apparatus for improving the arms embargo against South Africa. Because the US government is in the lead in perfecting COCOM embargo measures (1978 more than 60 % of motions to improve the embargo of military hardware against the East came from the US), a look at the American approach to this embargo may be helpful to assess the potential of the application of COCOM-type measures against South Africa. Apparently, the Export Administration Act of 1979 exerts decisive influence, that the export of products should be prohibited or limited, which constitute for a "significant contribution to the military potential" of an adversary (Public Law 96-72 of Sept. 29, 1979, Section 2 (5)). This formulation can be found unchanged in the revision of the "Export Administration Act", as introduced by the Reagan administration.

The American initiative is especially interesting because of the effort to deal with dual-purpose items. Three criteria are established, which make dual-purpose items eligible for the embargo: (1) Whether the product "is principally used in peace time for the development, production, or use of arms", (2)

whether the product provides for technology "of military significance", and (3) whether "items of military significance in which the prescribed countries have a deficiency should be embargoed."

More recently, the United States tried to develop COCOM into the embargo of "critical technologies". In January 1982, the US presented to COCOM evidence of the claim, that the USSR has managed by importing nominally civilian technologies to improve her military capabilities rapidly and cheaply. The strategic embargo should not only cover specific products of a military nature, but should be expanded to critical technologies, in the areas of computer technology, software, tele-communications, micro-electronics, and fibre optics.

Apparently, the position of the US government was strongly influenced by the so-called Bucy report. In 1976, a commission headed by the President of Texas Instruments, J. Fred Bucy, demanded:

"To preserve US lead time, export should be denied if a technology represents a revolutionary advance to the receiving nation".

The Bucy report concluded, that the export of "design and manufacturing know-how" should strictly be limited even if the intended end use would definitely be of a non-military nature. These recommendations are explicitly to be found in the "export administration act of 1979", and following US legislation. The revisions submitted by the Reagan administration to Congress in April 1983 suggest a comprehensive list of items which ought to be controlled. The peak of efforts to control the transfer of strategic goods to the Eastern block may be seen in the proposal by Senator Jake Garn to establish an "Office for Strategic Trade", which should have extraordinary powers to control licensing and exports to socialist countries.

At least in theory, this US approach potentially could be applied to the UN mandatory arms embargo against South Africa. One could go even as far as to the Garn proposal to establish a special authority. The question remains why this is not done. It has repeatedly been suggested that the COCOM approach should be used

to implement the arms embargo against South Africa. The World Campaign has even supplied the COCOM list to the Security Council's 421 Committee. Apparently, this has produced no results.

In evaluation, the parallel between the COCOM approach and the approach to the embargo against the delivery of weapons to South Africa remains meaningful. For an effective military and nuclear embargo against nuclear collaboration with South Africa, the Seminar would be well advised if it studies the push for the effectuation of COCOM instruments.

6. Conclusion

In order to strengthen the embargo, and to indicate how that can be done, firstly, the parallels from the preceding section should be ascertained. On the level of means to enforce an embargo, the COCOM system suggests strong means to progress to a more active embargo.

Because of the nature of the conflict in the region and the role of South Africa in this conflict, there should be added responsibility on states to enforce a more effective embargo. When the present South African regime has learned to live with the conditions posed upon it by the embargo, and if it turns to multinational corporations as well as the acquisition of components of a dual-purpose nature on world markets, then the world community has got to react accordingly. It will remain impossible to negate any export item to South Africa which will have a final military or repressive end use. But it should be possible to organize a campaign which denies a sufficient number of those items to South Africa. Guidance to establish a list of such items can be taken from the recent efforts by the US government to substantiate the COCOM list of prohibitions of exports to socialist countries.

The most general conclusion suggested in this analysis remains twofold. First, there is a technological finding. The stage of production in arms manufacturing which can be affected by the embargo has shifted from final assembly to subassemblies and components. Second, the actors in violating the embargo have

shifted. Multinational companies and their international transfers appear, connected with the first finding, by now as the crucial element in the embargo. The thrust of future embargo measures hence must aim at these two regimes of activity.

Table 10.4. South African sources of arms production technology

Weapon system	Type of technology	Origin	Start of design work	Start of production
<i>Aircraft</i>				
Impala 1	Licence	Italy	1966	1966
Impala 2	Add-on engineering	Italy/SA	(1974)	(1974)
C-4M Kudu	Add-on engineering	Italy/SA	(1973)	1975
Mirage F-1	Assembly/licence	France	1971	(1972)
Mirage F-1C	Licence	France	1971	(1972)
<i>Armour and artillery</i>				
AML 60/90	Licence	France	1962	(1966)
Eland 60/90	Add-on engineering	France/SA	1970	(1973)
Eland 20	Add-on engineering	France/SA	(1980)	(1981)
Ratel 20	Add-on engineering	Belgium/SA	(1975)	(1975)
Ratel 60	Add-on engineering	Belgium/SA	(1980)	(1981)
Ratel 90	Add-on engineering	Belgium/SA	(1980)	(1981)
Ratel Log	Add-on engineering	Belgium/SA	(1981)	(1982)
Safire	Indigenous	SA	(1980)	Not produced
Casspir	Add-up engineering	SA/FRG	(1974)	(1975)
Hippo	Add-up engineering	SA	(1974)	(1976)
Buffel	Add-up engineering	SA/FRG	(1977)	1978
Samil-100 APC	Add-up engineering	SA/FRG	(1980)	(1982)
G-5 155-mm	Add-on engineering	Canada/SA	(1976)	(1979)
G-6 155-mm	Add-on engineering	Canada/SA	(1979)	(1985)
<i>Missiles</i>				
Whiplash	Foreign experts	SA/FRG	(1964)	Not produced
V-3A	Add-on engineering	France/SA	(1971)	(1975)
Kukri	Add-on engineering	France/SA	(1978)	(1979)
<i>Ships</i>				
P-1558 Type	(Indigenous)	SA	(1974)	(1975)
Reshef Class	Licence	Israel	1975	1978
<i>Selected ordnance</i>				
R1 rifle	Licence	Belgium	(1961)	(1961)
Uzi SMG	Licence	Belgium/Israel	(1955)	(1955)
MG4	Licence	USA	(1962)	(1964)
60/81-mm mortar	Licence	France	(1963)	(1963)
MPS SMG	Indigenous	SA	(1970)	Not produced
Mamba pistol	Indigenous	SA	(1975)	(1976)
R4 rifle	Add-on engineering	Israel	(1977)	(1977)
R5 carbine	Add-on engineering	Israel	(1977)	(1978)
<i>Selected other items</i>				
Valkiri	Add-up engineering	SA	(1976)	(1979)
Samil 20/50/100 truck	Add-on engineering	(FRG)/SA	(1975)	(1977)
Eyrie RPV	(Indigenous)	SA	(1972)	(Produced)

Source: SIPRI.

Source: Michael Brozka/Thomas Ohlson (Ed.),
Arms Production in the Third World,
SIPRI, London and Philadelphia 1986