

Defence Diversification: International learning for Trident jobs

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Executive Summary

Employment in the UK arms industry has been in decline for several decades. The arms industry lobby group ADS estimates that in 2016 the industry employed 142,000 people directly in the UK¹. This is down from previous UK Government estimates of 155,000 jobs in 2000/01 and 405,000 jobs in 1980/81². This decline is a long-term downward trend in employment in the UK arms industry³ due to the increasingly capital-intensive nature of the work carried out in the UK, automation, globalised supply chains, limited increases in defence spending and a highly competitive arms export market.

Despite the 2016 Parliamentary vote to replace the UK's Trident nuclear weapons system, uncertainties remain over the future of the programme, particularly in terms of affordability, technical feasibility and political commitment (especially if the Treaty for the Prohibition of Nuclear Weapons is ratified internationally). There remains the possibility that in the event of a change of government at the next UK general election, the project will be scaled back or wound down.

This report explores how defence diversification as it has been demonstrated in international case studies, can be used to tackle the opportunities and challenges brought about by changes in defence spending and its effects on employment in the UK.

Our findings show that the best ideas and innovations come from the workers and affected communities – but on their own, these are not enough for success. A broad partnership is needed to tackle the issues, and for the best chance of success the arms companies themselves, national and local government, unions, civil society, academia and other stakeholders must fulfil their role in supporting workers and affected communities in making decisions for their future. This coalition must be given appropriate support in organising, analysis and planning as well as implementation.

However, even where diversification has been deemed to be a success, the costs of the reallocation of resources from military industry to civil production should not be understated. There is a real cost for workers and communities, especially where new economic activity cannot be created in the same location through an idealised plant-based conversion programme. Every international case study identified has involved substantial job losses in the short term.

On the other hand, economic transition always results in upheaval, and 'do nothing' is not an option: trends in defence spending and markets show that employment in the defence manufacturing sector is already shrinking. Diversification should not be portrayed as a manifesto to save every job but a tool to mitigate the impacts of change and provide opportunities.

There is good data on the number of jobs affected by changes in the UK arms industry or specifically Trident. The UK arms industry now directly employs an estimated 142,000 people while according to a CND study only approximately 11,000 jobs are currently supported by Trident. The employment supported by replacing Trident meanwhile is estimated at between 26,000 and 30,000 with many of those jobs not appearing until after new submarines come into service in 2031.

Cancelling Trident's replacement does not inherently mean putting this number of people out of work but consideration could be given to the regions most heavily dependent on the UK arms industry. The costs of the international diversification programmes are tiny in contrast to the cost of Trident's replacement which is estimated to cost between £140bn and £205bn over its lifetime.

There is already interest and support from civil society in diversification at the locations most affected by cancellation of Trident's replacement with proposals having been made for each location putting forward opportunities for diversification.

Several trade unions as well as Labour leader Jeremy Corbyn have called for a government Defence Diversification Agency that could provide coordination, assistance and funding to diversification efforts. In 2017 the TUC Congress voted for Motion 17 which committed it to lobbying the Labour Party to set up a Shadow Defence Diversification Agency before the next general election, and work to develop a national industrial strategy which includes the possibility of arms conversion. To help such a project succeed the lessons from international experiences of defence diversification must be learned.

- Workers and communities must take the lead in making decisions for diversification, but a broad partnership involving all stakeholders is necessary for success.
- Political support for diversification must come from national, regional and local levels.
- Action must be taken at early stages to proactively assist communities in diversification, rather than reacting to a crisis. Suggested timelines to organise and plan for diversification range from three to five years as a minimum.
- Funding must be available not just for putting a plan into action but for organising, analysis of the situation, planning and then implementation.
- Existing organisations, relationships and expertise must be identified and taken advantage of and efforts should be made to ease the transition into more competitive civil markets. Joint ventures and network learning should be encouraged.

Introduction

Objectives and methodology

This report aims to build on the findings of previous research by the Nuclear Education Trust and other organisations on how the processes of defence diversification can be used to tackle the opportunities and challenges brought about by changes in defence spending and its effects on employment in the UK.

This report focuses on international experiences of defence diversification, their successes and failures and attempts to identify the lessons that can be learned and applied in the UK context. A literature review was conducted, supplemented and guided by limited interviews held with academics, campaigners and government experts.

Particular attention is paid to the prospects for diversification in the event of the cancellation of the planned replacement for the UK Trident nuclear weapons system given the on-going debate about the programme. Despite the 2016 Parliamentary vote to replace the UK's Trident nuclear weapons system, uncertainties remain over the future of the programme, particularly in terms of affordability, technical feasibility and political commitment (especially if the 2017 UN Treaty on the Prohibition of Nuclear Weapons comes into legal force as expected). There remains the possibility that in the event of a change of government at the next UK general election, the project will be scaled back or wound down.

One of the reasons sometimes given in favour of replacing Trident is that the programme is essential to maintain employment in certain areas. This argument is attractive to many in the trade union movement and Labour Party who might otherwise oppose Trident replacement. The issue, for them, is about the potential loss of highly skilled employment clusters in these areas.

This analysis aims to inform this debate by drawing on international experiences to help workers, communities, campaigners and policy makers to make the best choices for our society.

Why should the UK consider defence diversification?

Changes in military spending and employment are not a new phenomenon. Policy decisions are taken every year on the acquisition of new military equipment from companies, bases are opened and closed and military equipment businesses start up and go out of business.

Employment in the UK arms industry has been in decline for several decades. The arms industry lobby group ADS estimates that in 2016 the industry employed 142,000 people directly in the UK⁴. This is down from previous UK Government estimates of 155,000 jobs in 2000/01 and 405,000 jobs in 1980/81⁵. This decline is a long-term downward trend in employment in the UK arms industry⁶ due to the increasingly capital-intensive nature of the work carried out in the UK, automation, globalised supply chains, limited increases in defence spending and a highly competitive arms export market.

The UK has been shedding arms industry jobs in great numbers for many years but the UK Government has never adopted a formal strategy for arms producers to diversify away from military work. The UK

government's main response over time has been the promotion of arms exports, however this subset of UK arms industry jobs has also been declining regardless. The UK's arms export industry's direct employment dropped from 140,000 jobs in 1980/81 to 70,000 in 2000/01 to around 55,000 as estimated by the ADS Group in 2010⁷.

There are two clear approaches that can be taken in public policy for dealing with the economic consequences of military spending cuts and the loss of employment in the arms industry.

The first is to leave the matter to market forces and for government to provide no more assistance or support to arms companies and their workers than would be expected in any other market sector. However, markets can be inefficient. There may be a lack of opportunities in the local area for workers made redundant or a lack of resources for them to find the information they need, to relocate or retrain. These issues may be particularly acute where military production or bases are intentionally put in remote areas or where an undiversified military industry has concentrated in an area leaving it heavily dependent on government contracts. Furthermore, costs may be incurred in the reuse of land where military or industrial use requires environmental hazards to be cleaned up due to the use of chemicals or nuclear material.

The alternative is tempting: for government to intervene to provide special funds or support in the specific case of the arms industry, in order to help workers and businesses find new markets, retool plants or retrain.

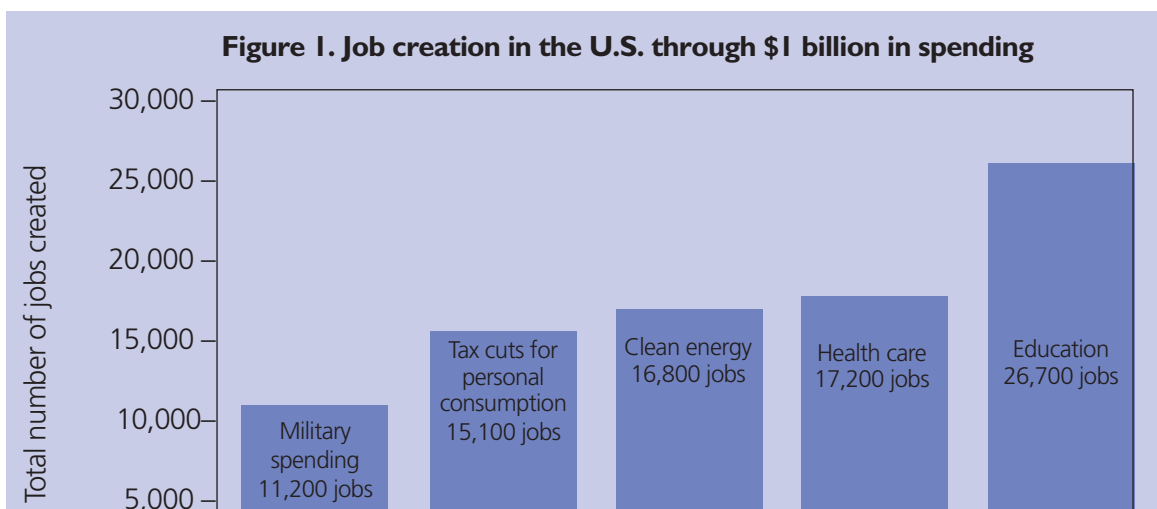
The Swedish expert Inga Thorsson maintained that the arms industry should receive special attention for three reasons. First, that disarmament should not lead to unemployment as this would be a perverse disincentive for peace and reductions in military expenditure. Second, that incentives for the transfer of resources from the defence sector to civilian production were vital in order to develop a country's industrial and technological base as well as provide employment. This is especially relevant where arms industry workers have particularly valuable skills and knowledge that have been built up working on government contracts. These workers' abilities can therefore be thought of as a national asset that should not be squandered. Thirdly, that the arms industry's principal customer is the government, on whose behalf resources were committed to weapons manufacture. Therefore, there is a societal obligation to help return them to commonality with their civilian counterparts.⁸

This viewpoint should not be ignored. There are valid arguments why the UK arms industry should not receive special attention in preference to other socially useful sectors. It should certainly be asked whether any diversification project is a better use of public funds than a project to support healthcare or education or another sector. However, this report assumes that there is interest in taking action to mitigate the impacts of cuts to military spending and the wider loss of jobs in the arms industry.

However, there are wider economic benefits for reducing the spending on military projects. The prospect of reducing military spending offers a 'peace dividend' from the transfer of resources from military uses to civilian uses. This transfer leads to improved economic performance by avoiding the harm to people, the property, markets and the environment caused by conflict as well as diverting resources towards products and services that are available to be used by the public rather than products provided to governments for

the purpose of war, where the best-case scenario is that these weapons are never used.

Furthermore, as military spending has become increasingly capital-intensive it produces relatively few jobs. A University of Massachusetts study concluded that, if the US government invested \$1 billion in alternative civilian sectors rather than on military production, it would generate up to 140% more jobs. Investments in clean energy, health care and education also create a much larger number of jobs across all pay ranges, including mid-range jobs (paying between US\$32,000 and US\$64,000) and high-paying jobs (paying over US\$64,000). The study also considered direct, indirect and induced jobs in each case⁹. A summary of their findings is shown in Figure 1.



The meaning of diversification, conversion and related terms

The use of the terms ‘arms conversion’, ‘defence diversification’ and other related issues such as ‘economic adjustment’ are not always used consistently and understanding of what they mean often differs between countries and authors. Some clarification of the intended meanings in this report may therefore be useful to prevent confusion.

The broader concept of ‘economic conversion’ was defined by Kenneth Boulding in 1960 as “...the problem of how to adjust the structure of production in the economy – that is, the commodity mix of total output – to shifts in the structure of total demand, public and private.”¹⁰

Economic conversion as it applies to the arms industry, described as ‘arms conversion’, is therefore a more specific term which Seymour Melman described saying “Economic conversion from military to civilian economy is the formulation, planning and execution of organisation, technological, occupational and economic changes required to turn industry, laboratories, training institutions, bases, and other facilities from military to civilian use.”¹¹

‘Defence diversification’ is sometimes used interchangeably with arms conversion but typically in the UK it is also understood to mean the entry into a different business field or the marketing of alternative products. Different authors interpret this to mean either businesses moving out of military work into explicitly non-military fields and markets, or in some contexts, to mean finding additional business in other military markets or new civilian markets without ending the current military work. In this report ‘defence

diversification' is taken to mean the broadening of business to non-military business fields with the intention of reducing or stopping arms production.

Both the terms 'arms conversion' and 'defence diversification' can be applied at both the micro level of the community, factory or business, and the macro level of a country, region or industry. In this report, initiatives which are aimed to help create change at any or all of these levels will be examined.

The Lucas Plan

UK awareness of defence diversification has largely stemmed from the discussions of the ambitious 1970s Lucas Plan. The Lucas Plan was a ground-breaking union-led proposal to protect jobs threatened by redundancy at Lucas Aerospace. 50% of Lucas's output was reliant on military contracts but significant redundancies were threatened due to defence cuts. A multi-union combined shop stewards' committee drew up a plan which proposed to save jobs by converting workers' skills and facilities to new products. The plan aimed to "protect our members' right to work" and propose alternative products that would be "socially useful to the community at large"¹². Among the 150 proposed alternative products that Lucas could produce were several that have now become mainstream; wind turbines; hybrid car engines; cheap heating systems and medical products such as dialysis machines¹³.

The alternative plan for Lucas proposed by the workers gained widespread support and became an international cause célèbre for the ideas proposed, the roles of workers in promoting socially useful products and in their challenge to the right of managers to manage¹⁴. However, the Lucas Plan was ultimately unsuccessful in securing the cooperation from the company's management and there is no way to say whether the plan if enacted would have been successful in saving jobs at the company at the time.

The Lucas Plan was, however, undeniably successful in providing inspiration and a touchstone case for defence diversification.

The UK's first Defence Diversification Agency

During his campaign for election as leader of the Labour Party, Jeremy Corbyn proposed the creation of a Defence Diversification Agency to mitigate the impacts of job losses when the Trident nuclear programme comes to an end. However, it should be noted that the UK has had a Defence Diversification Agency (DDA) in the past. This was set up in 1999 as a subgroup of the Defence Evaluation and Research Agency (DERA), part of the Ministry of Defence (MoD). The focus of this agency was on technology transfer or the spin-off of intellectual property from arms production to civil products – without any defined focus on the transfer of employment from arms production to civil production.

A 2003 report by the Department of Trade and Industry credited the DDA with some success, saying that in their four years of operation their work had benefited some 2,300 companies. Examples of successful technology transfer given included the "application of advanced optics from within the stealth domain to improve paint curing on pencils;" the "joint defence/industry development of a non-contact sensor for remote analysis of contaminants" and the "development and testing of novel polymers for use in building products"¹⁵.

DERA was part privatised in 2001 and concerns were raised in Parliament by the Defence Committee that neither the privatised body nor the remaining public organisation, which became the Defence

Science and Technology Laboratory (DSTL) would be good fits for the DDA and its purpose could lose it institutional support¹⁶.

These concerns appear to have been well founded. A 2007 report by the Parliamentary Defence Committee heard from the MoD that in fact ‘The DDA’s main remit had been to work with Small and Medium-size Enterprises’ and ‘to look at spinning in technology into MoD’, a different task entirely to the originally proposed mission of the agency, raising questions as to whether the agency’s mission drifted over time. The committee’s report concluded that ‘we are unclear about what exactly it [DDA] does or why—if the MoD thinks there is no clear requirement for the service the DDA offers—it still exists. We look to the MoD to make a swift decision on the future of the DDA.’¹⁷ The agency was announced to be closing a month afterwards¹⁸.

Other significant UK state encouragement has been given to arms export promotion through marketing, diplomatic and financial support. This type of support, which is particularly heavily weighted towards exports of arms over other civil sectors, encourages a greater concentration of businesses on arms production rather than diversifying into civil production .

International learning

The direct conversion methodology on a plant level, as proposed in the Lucas Plan, is only one form of attempting to preserve jobs and economic activity when moving away from military production. Diversification away from arms production can take place on a range of scales from a factory or company level to a community, region or national level.

With the reduction in resources for military purposes, workers may find themselves unemployed, may require retraining or may have to move to a new location. Former military plants or facilities may not be easily re-used by new entrepreneurs and in extreme cases may be hazardous due to unexploded ordnance or the use of chemicals or nuclear material. In some cases, facilities may have to be abandoned, making plant-based conversion impossible.

At the end of the Cold War significant time, thought and resources were devoted to trying to realise the “peace dividend” from large reductions in military spending and also to deal with the challenges of nationwide defence production slowdowns and the decommissioning of military facilities. These moves prompted national government policies and regional reactions, which in former Soviet states were massively complicated by the shift to market-based economies. The government responses largely centred on regional approaches to ease diversification away from military production.

Regional responses generally deal better with assisting not only major companies but also small firms. Smaller companies supplying components rather than end products, are likelier to be more able to convert their business to civil work than large firms, especially vertically integrated prime contractors. Small and Medium Enterprises (SMEs) can often convert their business to civilian purposes more easily as their technology and business model is rarely as specialised as large businesses – and is therefore more adaptable.

Both South African and some former Soviet experiences had an added dimension with both having had active nuclear weapons programmes that required specific responses to mitigate the danger of putting disaffected nuclear weapons experts out of work and making their specialist knowledge available to enable the clandestine proliferation of nuclear technology.

More recently, with the latest push beginning under President Obama, the United States has invested in defence diversification programmes that offer a region-based, community-orientated programme that puts the emphasis on empowering local communities to choose how to use resources to help themselves.

Each of these country level experiences will be discussed in more depth below and key learning drawn from them. The application of the different models and the key learning will then be discussed with reference to the current opportunities for diversification in the UK around the Trident nuclear weapons programme, including the current political appetite for action.

International experiences

United States

The United States has a number of long running projects to mitigate the impact of base closures and also to assist diversification to either other military or non-military business. The US government refers to these collectively as the Defence Industry Adjustment programme (DIA).

The programme is run through the Office of Economic Adjustment (OEA) which is funded by the US Department of Defense (DOD)²⁰. The programme's stated aims include assisting states and communities to address challenges including replacing the jobs lost through DOD action and regional economic impacts from spending cuts, creating capacities to plan and carry out redevelopment of the former installation²¹.

The programme is not primarily intended to be part of an explicit disarmament policy and is partly targeted at ensuring the ability of arms producers, including those down the supply chain, to fulfil future military contracts.

The DIA programme requested a budget of US\$33.1m in 2016 and is funded until 2018²². Technical assistance and monitoring of the programme is handled by the Center for Regional Economic Competitiveness (CREC), a non-profit organisation²³.

It is currently working with 44 communities across the United States that are at various stages of the programme²⁴. Communities are loosely defined to include groups within the geographic confines of states, regions or grouping of states.

The level of support each grantee receives varies significantly. However, one consistent factor is a requirement for matching support from local government. In order to be funded, communities have to show that they are affected by DOD cuts or are at risk. An important difference from diversification programmes in other countries is that the OEA funds communities or their services providers and not companies²⁵.

The OEA model has a four-stage process for diversification and each stage requires agreement from the OEA²⁶:

1. Organising – A coalition of stakeholders is gathered together, including local government, affected companies, military representatives, academics and civil society groups. The group should be able to make an assessment of resources in the community, determining what services could be provided to affected companies and workers.
2. Gathering data – The group then attempts to identify the businesses that need help. An asset analysis is carried out to see what resources are available and an assessment is made of what contribution businesses are making to the community. This data can often be made public with several groups publishing supply chain maps for example²⁷.
3. Planning – A defence diversification action plan is written, typically involving workforce development plans, plant re-use plans and economic diversification in general (not just diversifying from defence).
4. Implementation – Ideally it takes 2-3 years to reach this step at which point the plan is put into action with monitoring and evaluation following.

While the plans are put together by the community groups five strategies that are recommended by the OEA are:

- Entrepreneurship and Small Business Development
- Export Promotion
- Industry Cluster Development
- Manufacturing and Supply Chain Mapping
- Enhancing Workforce Development²⁸

It should be noted that the inclusion of arms export promotion shows that the DIA programme is aimed at diversification to both non-military and other military business.

Common challenges found so far in the programme are that communities do not always have expertise related to the required analysis, such as supply chain mapping (which can be quite technical) or with the strategies mentioned above, plus only limited numbers of companies may be interested in taking part²⁹.

Success thus far has been attributed to the focus on helping communities organise, analyse and plan as well as supporting implementation. This has led to communities achieving much more by finding solutions that fit their own needs³⁰.

Key lessons have also been learnt at each of the stages of the programme. At the organising stage, groups are now encouraged to work with existing organisations rather than trying to reinvent the wheel. At the analysis stage, substantial amounts of time and money had been spent on conducting complex supply chain analyses when it would have been easier to talk immediately to partners already engaged rather than waiting months for a formal study to start outreach. At the planning stage, groups have had difficulties finding measurable outcomes to show success and so are being given more support for this³¹.

CREC contacts each grantee at least once a year, to get an update and can provide technical assistance and guidance. It can also connect groups in the network together. Learning communities on specific subjects have also been set up around supply chains, workforce development, entrepreneurship and higher

education. CREC also provides webinars and in-depth face to face meetings as well as providing a bi-weekly newsletter with links to stories, in order to remind groups of the outside assistance available.

Network learning is also encouraged in the programme with an annual conference for all the grantees to update them on DoD funding and provide a space for them to talk about their experiences with each other³².

Criticism of the DIA programme however has focused on the lack of emphasis on diversifying beyond arms production. One example of a successful community initiative has been run jointly by the University of Michigan, Purdue, and Ohio State. They report having worked with 101 companies and 28 communities since 2014. Results from the first grant include 4,153 jobs retained, 273 created, and \$310 million in new sales. However, as the academic Miriam Pemberton reports, no record has been kept of whether these new jobs were in military or civil work.

This lack of focus on truly diversifying beyond military work is likely to be a consequence of political considerations. As Pemberton puts it: “Encountering the OEA line item in the Pentagon’s budget, some congressional committee members can usually be relied on to ask, “What’s in this for the warfighter?” So, staying under the radar has been an agency priority for years.”³³

In conclusion, the DIA programme offers an established model of how to help local communities deal with the impact of changes in military spending. However, questions still have to be answered as to whether enough focus has been placed on diversifying out of military work.

Key lessons

- The Office of Economic Adjustment funds communities or their service providers and not defence companies.
- Projects are run through a coalition of stakeholders including local government, affected companies, military representatives, academics and civil society groups.
- Emphasis is on helping communities organise, analyse and plan so they can find solutions that fit their own needs.
- The OEA's projects aim to encourage economic diversification, business development, and export promotion in general, not just diversification from defence production.
- A staged approach assists OEA in managing projects.
- Projects encourage work with existing organisations and dialogue with potential partners.
- Network learning and information provision is strongly encouraged.

Italy

In the 1990s Italy enacted large post Cold War cuts to military spending in common with many European countries. In 1995, the Italian state arms procurement budget was at 50% of its 1988 level in real terms³⁴.

The largest arms manufacturers in Italy, IRI (which owned Finmeccanica), EFIM and Fiat, all separately attempted to diversify some of their business, carrying out feasibility studies into producing and marketing civilian goods. However, no consistent strategy emerged and there was no clear attempt to change the fundamental military orientation of these arms-producing firms.

There were smaller firms and several regions which took up funding available from both the Italian government and European-wide programmes to diversify away from military production.

In 1988, workers and unions at the 90% military aerospace company AerMacchi, proposed to management that the company agree a diversification strategy. The trade unions then took on a ground-breaking role of verifying the progress made by the company on the agreement.

As a consequence, AerMacchi began working with the German aerospace firm Dornier to co-produce a civilian aircraft. AerMacchi did reduce the proportion of its military work, and by 1995 a third of the company's business was in civilian aerospace but this transition was not without significant job losses. In 1990, there were 2,706 employees at AerMacchi; this number dropped to 1,423 in 1994, with 300 more workers temporarily laid off.

In 1991, BPD Difesa e Spazio, a Fiat subsidiary which produced ammunition, rockets and propellants for rocket engines, undertook a project for converting its plant at Colleferro, near Rome, which was facing closure due to procurement budget cuts.

The project aimed to use the skills of BPD workers in dealing with explosives for producing exploding caps for rapidly inflatable air-bags for cars. The company established a joint venture between BPD and two major US major producers of air-bags (Allied Signal and Atlantic Research). BPD aimed to supply its air-bags not only to the Fiat plants but also other car producers.

The BPD case's relative success was attributed in part to the company's successful identification of a market and customer base for the eventual products, helpfully including BPD's parent company Fiat as well as working with established producers to use their commercial structure for promoting the new product. BPD workers were also able to work with local government and take advantage of European Union funds through the regional adjustment and diversification KONVER programme to access retraining programmes.

The KONVER programme, which ran from 1993 to 1997 offered funding to regions and individual companies that wished to diversify from military to civil production³⁵.

Perani, an author who studied these Italian cases, noted several other key factors for the success of these plant-based conversion cases:

- the degree of involvement of the management;
- the support by the public authorities;
- the novelty of the designed products and their potential market.

Perani also noted that a key lesson from the Italian experience was that a regional policy approach was clearly needed, saying: "Attempts to change the final output and, more relevant, the organisational structure in order to reduce costs of large military firms will probably find insurmountable obstacles in the rigidity of 'military' production processes and in the technological weakness of the Italian military-related sectors. A more useful attitude may be to evaluate the potential of areas hit by industrial crisis and defining a recovery plan aimed at employing existing resources in the most productive ways. New activities, dealing

with both industries and services, may develop while traditional (industrial and/or military) activities can be reduced: the focus here is on flexibility and on the best possible use of local resources.”

The advantages of encouraging SMEs, and at that time the innovative use of science parks and business incubators, were also pointed to as potential engines for a new entrepreneurial use of the special skills and knowledge that could be transferred into the civilian sector.³⁶

Key lessons

- A regional strategy based on assisting the development of spin-off companies and SMEs in support of the broader regional economy worked best.
- A partnership approach involving company management, trade unions, staff, national and local government all working together is a vital ingredient for successful diversification initiatives.
- Plans need to focus on flexibility and best use of resources.
- Support for SME's and use of science parks and business incubators can be engines for new entrepreneurial use of skills and knowledge that could be transferred into the civilian sector.
- Start-up funding must be provided to allow diversification projects to succeed.
- If possible, take advantage of existing relationships to develop a customer base for new non-military products.
- Establish joint ventures with existing producers in a sector.
- Designed products must be novel and have a potential market.

Germany

The port city and German state of Bremen was Germany's most military-dependent state. Industry was centred around the linked clusters of shipbuilding, steelworks, the electronics industry and the aerospace industry, producing parts for the Tornado and Eurofighter (renamed Typhoon) jets, rockets and parts for the International Space Station.

Bremen had a high regional dependency on military business both from a quantitative (jobs, net output) and qualitative (innovation potential, qualification level, system capabilities) point of view and therefore possessed a high regional vulnerability to disarmament. According to a 1992 European Community (EC) study³⁷, Bremen ranked third on the list of the EC regions most dependent on defence industries and vulnerable to defence cuts with 5.5% of the working population's jobs at risk³⁸.

At the start of the diversification process in Bremen in 1989, 16% of the industrial work force were employed either directly or indirectly in military-oriented companies. The sector included around a dozen large or medium sized enterprises, some of them, especially the dockyards, acting as prime contractors. Of the defence-dependent workforce 40% were involved in the electronics industry, 31% in shipbuilding and 25% in aerospace and vehicle production³⁹.

Bremen's arms companies were not however “pure play” arms companies, rather they already had a substantial amount of non-military business. In 1990 the average defence dependency of Bremen's arms companies was 39%, dropping to 33% in 1995⁴⁰.

Bremen had a history of severe and rapid structural economic changes over its history and had a track record of activist industrial policy responses. In the early 1980s Bremen started an industrial policy called the Structural Policy Action Program (AP) and grew its funding from around \$40m per year to around \$300m by the late 1990s. One of the 25 support programmes was the Bremen Industrial Defence Conversion Program (CP). The AP was part-funded by national and European Community funds.

Furthermore, workers had also taken matters into their own hands and established a network of union-organised company-based working groups on alternative products in the 1970s which developed many civilian product proposals. Workers were therefore well prepared to take part in discussions of diversification in 1989.

Similarly, academic debate on diversification had been active in the region and between this and the union-based debates, local government was well informed about and interested in the concept of diversification. In 1989 the governing Social Democratic Party state president and former ministers participated with trade unionists, peace movement activists, religious representatives and political party representatives to create the private Bremen Foundation for Defence Conversion and Peace Research in 1989⁴¹.

When the threat of post Cold War defence cuts loomed, a Bremen Disarmament and Conversion report was prepared in 1990 through a social process including hearings involving all of the above participants. Also included were company managers, company employees' representatives, and business and employees' chambers and associations. Prior to this time, business representatives had not actively participated in conversion discussions⁴².

A state official for "defence conversion" was also appointed to coordinate a consultancy committee, the production of company plans and projects, the financial operation of the project, and reporting to and maintaining connections with the national government and European Community. In addition, a committee formed of the main stakeholders was given an oversight role⁴³.

There was formal adoption of the Bremen defence conversion programme in 1992 with support guidelines for companies. These contained a regional economic approach for supporting structural change. The programme applied instruments, experience, funds and projects of the existing comprehensive Bremen programme for structural policy.

Bremen worked with the regions of Lancashire and Zaanstand in Netherlands in the first, small interregional cooperation network called DEMILITARIZED funded by the EC. The network proposed that the EC should support diversification for the long-term in 1991. The European Community responded by creating 'Perifra' programmes in 1991 and 1992, to assist peripheral and fragile regions affected by changing international conditions, including disarmament. Perifra was replaced by the KONVER initiative in 1993 which funded the conversion of military sites. Bremen took advantage of co-funding from these funds for their projects⁴⁴.

In order to receive support, firms were required to provide a medium-term (3-5 years) company conversion plan as well as a detailed 1-2 year plan, and priority was given to those integrating their projects

to include R&D, qualification, marketing and organizational development (including spin-offs). Companies were also discouraged from some activities, such as proposing dual-use strategies without any extra R&D work. The programme emphasised networking to enhance the regional effects of diversification and encouraged cooperation between companies, especially SMEs and civil companies, or with regional research institutes⁴⁵.

From 1992 Bremen supported over 50 company conversion projects and around 5 conversion-related infrastructure projects. The venture was considered a remarkable success and it was recommended as a model by the EC. However, one major failure of the programme was that the largest shipbuilding company, Bremen Vulkan corporation, did not participate and went bankrupt in 1996 due to the lack of diversification strategies for its shipbuilding work. There were also significant staff lay-offs, including later in the process, in order for companies to be competitive in civil markets. However, statistics showed that 50% of the decrease in defence employment in the region was reclaimed with 11% of the Bremen arms company employment changing from military to civil work by 1997.⁴⁶

The Bremen experience showed that incentives and state support in the medium-term helped overcome companies' institutional resistance to diversification in the event of uncertainty in both civil and military markets. The networking and regional approach of Bremen also prevented companies pursuing individualistic strategies of trying to grab the larger slice of a shrinking defence budget or compete for difficult overseas markets. Instead, co-ordinated behaviour to benefit the region was agreed upon by a wide range of empowered stakeholders that had longer-term effects for the common good.

The Bremen example shows the importance of local political and social interests which overcame the lukewarm-at-best interest from the German federal government. The coalition of stakeholders all contributing to the Bremen programme was crucial and allowed them to make the best use of flexible funds provided by local, federal and supranational bodies. This bottom-up strategy was considered highly successful in Bremen.⁴⁷

Key lessons

- The interest and support from workers, unions, local politicians and academics for diversification issues created a sound base to work from.
- Work commenced when the threat of post-Cold War defence cuts began to emerge, rather than waiting for a crisis point to be reached.
- The diversification process actively involved company managers, company employees' representatives, business and employees' chambers and associations as well as workers, government, and academia.
- A consultancy committee co-ordinated by government helped co-ordinate projects and provide oversight.
- The diversification programme was located as part of an existing regional economic approach for supporting structural change.
- The programme emphasised networking and co-operation between companies to enhance the regional effects of diversification and avoid competition through individualistic company strategies.
- Diversification projects were not able to save all jobs and significant staff lay-offs could not be avoided.

Estonia

Efforts to diversify and convert in former Soviet Union countries were more urgent and much more difficult than those in other countries at the end of the Cold War. Former Soviet Union countries were experiencing an enormously precipitous decline in military spending, a severe recession and a rapid shift to market economies. The lack of experience in markets proved a high barrier for most diversification projects. One interesting case though is that of Shipyard No. 7 in Tallinn, Estonia.

The shipyard was an important ship repair facility for the Russian Navy, and also performed some ship construction. All the shipyard's business was for its sole military client, or in support of housing and other services for the ethnic Russian workers at the shipyard. The project began after Estonia formally became independent, but while most Soviet military and trade infrastructures were still in place. The ethnic Russian population who made up the majority of the workforce at the shipyard and settled in Estonia since 1940, faced hostility from the Estonian population and an uncertain future. The top military commanders at Shipyard No. 7 were recalled to Moscow, and the shipyard reverted to Estonian ownership, eventually being transferred to the Estonian Ministry of Economics, known today as Tallinna Meretehas. Day-to-day management remained in the hands of the ethnic Russians who ran the workshops. Existing contracts for repairing Russian military ships continued, although the supply of raw materials from Russia became progressively more difficult and costly. The business relationships between the Russian customer and the ethnic Russian workforce endured. However, the downturn in business and general economic pressures forced a reduction of the workforce by almost a quarter between January 1991 and July 1992⁴⁸.

The attempted diversification of the shipyard is particularly interesting as an international co-operation project between civil society from Sweden, Estonia and Russia and the workers at the shipyard. The project came out of the voluntary activities of scientists and engineers in the peace movement who hosted conferences and formed the International Network of Engineers and Scientists for Global Responsibility (INES) in the 1980s and early 90s.

Swedish and Estonian post-graduate students put together a plan for the dockyard working together with Swedish members of INES, an Estonian professional engineering society (ETS) and Russian advisors. After an initial scoping phase this group gathered together business and financial representatives, government officials, academics and other researchers to develop proposals for diversification.

The shipyard had already succeeded in spinning off some civilian business with an acetylene and oxygen workshop (for gas welding) doing non-military business in 1990. By 1992, this small workshop did roughly half its work for the shipyard and the other half for about 70 other customers in Estonia and turned a small profit. While many diversification ideas were put forward by the assembled group of representatives the resultant work taken forward by the shipyard was largely of their own choosing.

Only one quarter of the workforce employed in 1991 remained in place after taking on repair work on fishing and other civilian vessels as well as small amounts of non-maritime work, such as the manufacture of wooden doors and the repair of railway wagons. Even as an exercise in diversification, the results were mixed as the shipyard went on to build a coastguard vessel for the Estonian state, essentially still a military product⁴⁹.

A study from Sweden carried out for a Masters' thesis, "Conversion of Shipyard No. 7 in Tallinn, Estonia - Not only a military/civilian conversion" concluded that the challenge of the diversification process in this case was as much about transition to Western economic and industrial practices as it was a transition from military to civilian production. The biggest barrier to diversification, they found, stemmed from the shipyard's place in a centrally planned economy and its consequent inexperience in commercial operations, cost control, pricing and marketing⁵⁰.

Key lessons

- Scientists and engineers played a key role in driving the project forward, working across international boundaries and in collaboration with workers at the shipyard.
- Although diversification proposals were put forward by academics and researchers, work taken forward by the shipyard was largely chosen by workers.
- Despite diversification initiatives, only one quarter of the workforce remained in place and the shipyard continued to undertake essentially military work as well as civilian work.
- The biggest barrier to diversification was the move from a centrally planned economy to a market economy and inexperience in commercial operations, cost control, pricing and marketing.

South Africa

The South African experience of government sector intervention to diversify during the transition to democracy was limited to the two state-owned enterprises Armscor and Denel. At no point between 1989 and early 1994 did the South African Government initiate any public policies to help private sector arms firms adjust⁵¹. However, there are useful lessons to be drawn from the experiences of the two companies, especially as South Africa is a rare example of a former nuclear armed state which has disarmed and attempted to convert facilities used in the production of nuclear weapons to other uses.

South Africa's arms industry by the end of the 1980s had a significant role in the national economy in terms of employment and contribution to national income. Substantial cuts in military expenditure were implemented in South Africa between 1989 and 1994 as part of a wider process of disarmament. In response to the cuts, the arms industry was forced to downsize and restructure, causing large-scale job losses, declining output and profitability and prompting a range of diversification strategies to be pursued⁵².

In 1989 Armscor, the state-owned arms company, was the 15th largest employer in the country with 30,000 employees⁵³. Armscor's public duties included supply of arms to the military, roles in procurement decision-making, and arms export regulation. Most of Armscor's adjustment strategy aimed not to preserve jobs but to ensure the company's survival as the key actor in the country's military industrial complex and survival of the country's domestic arms industry, justifying Armscor's corporate existence and influence in the state as well as obtaining better value for the company's procurement activities⁵⁴.

Armscor's adjustment strategy did not primarily involve substantial diversification into civil uses. Instead the company introduced:

- Competitive procurement policies emphasising value for money over cost-plus type contracts;
- Technology retention and development programmes to redeploy funds to preserve critical skills, design

capabilities and manufacturing processes for their envisioned future projects;

- Restructuring and rationalization programmes cutting at least 10,000 jobs.

Finally, the company radically shifted by starting to export arms, something previously barred by law. It did this by creating and transferring resources to a separate state-owned company, Denel, in 1992⁵⁵.

Denel aimed not only to export arms and form international joint ventures but also to diversify into some civil markets principally through spin off from military technology as well as acquisition of some civil firms such as Irengo.

Several civil products were created. The systems group in the company, which formerly took on prime contractor roles, made skid-steer loaders under a joint venture with Bell (Pty) Ltd and a tractor made jointly with Dendex. The manufacturing group within the company, which included the company's ammunition manufacturing, developed commercial explosive products for the mining industry as well as brass and pressed products for the automotive industry based on ammunition manufacturing technologies. Other groups licensed production of polyester pipes or moved from military to civilian satellites. As a result of these initiatives Denel's defence business as a share of turnover dropped from 63% to 53% in just one year from 1992 to 1993⁵⁶.

The transfer of Denel's business from military to civil production was however, far from smooth or cost-free. The groups with a higher degree of military business and military specific technology in particular suffered high reductions in turnover and found diversification more difficult. Houwteq, the subsidiary which converted 100% from military to civilian satellites, failed to find customers. The most successful transfer came from the company's informatics group which was least dependent on defence business and technology, instead it had transferrable skills in software and IT which largely originated in the civil sector. All Denel's efforts also probably suffered due to the severe domestic economic recession at the time⁵⁷.

Armcor's nuclear arms work, located at the Atomic Energy Corporation (AEC) bases in Pelindaba and Advena were dismantled after 1989 at the termination of the country's nuclear weapons programme. The facilities formerly used in the manufacture of nuclear material and weapons, were attempted to be commercialised and converted to civilian use. The AEC's pilot uranium enrichment plant at Pelindaba was decommissioned in 1990 and the remaining facilities regrouped into 11 business units, which all aimed to be independently profitable and would separately bear start up, capital and development costs. The groups were managed by a new state-owned unit called 'Pelindaba Technology Products' (PTP).

The new PTP businesses aimed to use their expertise in radioactive-isotopes, fluorochemicals, engineering systems and mechanical products which had been developed as a result of the uranium enrichment programme⁵⁸. In other respects, the new businesses followed a similar programme of diversification to Denel and looked for international customers, joint ventures and developed marketing strategies.

According to Karl Voigt, the Executive General Manager of PTP, the major problem of commercialisation involved 'retraining staff to think along business lines... previously it was a case of budgeting for expenditure and simply meeting that budget... now we have to think of generating income to satisfy shareholder [i.e. the state's] expectations.'

The Advena nuclear arms site had its staff and facilities absorbed into Denel in 1992. The group suffered 200 job cuts (from 1989 to 1993) and they too attempted to diversify into commercial products based on their knowledge of high explosives, pyrotechnics, metallurgy, high-speed electronics, environmental and reliability testing and ultra-high-speed diagnostics⁵⁵.

The Advena adjustment process in particular had difficulties because: “high overhead costs associated with fixed assets and a highly skilled (and expensive) workforce, customized to the (nuclear) weapons programme were not conducive to a competitive price structure needed for rapid commercial market penetration... The mindset of scientific and technical staff had to be converted from being technology driven to being market driven and business orientated”.⁶⁰

The examples of Armscor, Denel and PTP in South Africa demonstrates useful lessons reflected in other countries and lays down at least one blueprint for the diversification of nuclear weapons programmes. However, they also demonstrate that diversification comes at a high cost. Furthermore, all three companies remained under public ownership and probably did not suffer the immediate commercial pressures that would apply in the case of private companies.

Today Denel continues to provide some products and services to the civil aerospace market. However, it is far from diversified and relies heavily on military production and arms exports.⁶¹

Key lessons

- Competitive procurement practices were introduced emphasising value for money over cost-plus type contracts.
- Technology retention and development programmes were established to preserve critical skills, design capabilities, and manufacturing processes.
- Joint ventures were established with existing civilian manufacturers.
- Business groups with the highest degree of military business and military specific technology suffered highest reductions in turnover and found diversification more difficult.
- Groups which were least dependent on defence business and technology and had transferrable skills originating in the civil sector were most successful in converting to civilian sector work.
- A significant difficulty was retraining staff to think along market and business lines and to generate income, limit overheads, and operate competitively.

Diversification in the UK

Historical and political context

Long term job losses and questions raised over the cost and need for the UK major defence procurement projects suggest that the UK should consider supporting defence diversification projects that could mitigate the employment impacts of cutting national defence spending, specific military equipment programmes and arms exports.

As highlighted in the introduction there has been a massive decline the number of people employed by the UK arms industry, dropping from 405,000 people directly employed in 1980/81 to a 2010 estimate of only 142,000. This drop has been mirrored in the arms export-specific employment in the UK from 140,000 in 1980/81 to only 55,000 estimated direct jobs in 2010⁶².

There has also been a concentration of military production within fewer large arms firms in the UK, notably BAE Systems, which is now the fourth largest arms firm in the world employing 33,000 people in the UK⁶³. 95% of BAE Systems' turnover was in arms sales in 2016, the highest proportion in the 20 largest arms producers in the world. BAE's proportion of arms sales was 77% in 2002⁶⁴. As well as being a major player in the conventional defence and aerospace sector, BAE Systems also builds nuclear-powered submarines for the Royal Navy and leads the consortium building the new 'Dreadnought' class submarines, which are planned to carry Trident nuclear missiles from the early 2030s onwards.

The UK government published a new Defence Industrial Policy in December 2017⁶⁵, which emphasised the need for closer links between the arms industry and government but did not address the loss of jobs over time or attempt to address the possibilities for diversification.

The Defence Industrial Policy builds on the UK Government's National Shipbuilding Strategy, published in September 2017. The strategy focussed heavily on supplying the needs of the Royal Navy and highlighting the increased dependence on military shipbuilding in the UK. Notably the strategy laid out that the UK would only procure warships from the UK on the grounds of national security but would allow competition between UK shipyards, contrary to the previous policy that had left BAE Systems holding a near monopoly over naval procurement⁶⁶. While the strategy emphasises government support for naval arms exports, sales have been thin in recent years⁶⁷.

Despite the current Government's stated commitment to military spending there is controversy over the cost of many of the UK's large procurement projects and questions over their contribution to the UK security⁶⁸.

The UK's nuclear weapons programme is a significant element within the UK's defence equipment budget. The UK Government's 2015 Strategic Defence and Security Review confirmed that the costs of design and manufacture of four Dreadnought class submarines will be £31 billion while £10 billion is to be set aside as a contingency for overspending. The ongoing costs of operating the Trident programme, including the costs of the Atomic Weapons Establishment and the Nuclear Warhead Sustainment Capability Programme, basing, decommissioning and disposals, are expected account for 6% of the defence budget. On the basis of the defence budget growing with predicted real terms growth in gross

domestic product the running costs of the UK nuclear weapons programmes are estimated by House of Commons Library researchers at £140.5 billion for its possible lifetime of 2031-2061⁶⁹.

The Campaign for Nuclear Disarmament (CND) estimates that the life cycle cost of replacing Trident will be around £205 billion. That figure includes the cost of building new submarines estimated at £40bn⁷⁰.

The UK political position on replacing Trident has been mixed. The Conservative Party position in its most recent manifesto has been to retain the Trident continuous-at-sea nuclear weapons programme⁷¹ and in government the party has pushed forward with development of the new Dreadnought class submarines.

The Labour Party officially backs the replacement of Trident although Labour Party leader Jeremy Corbyn, a long-time supporter of nuclear disarmament, has declined to personally back the replacement. Corbyn has suggested that there would be a defence review to 'look at the role of nuclear weapons' should Labour come to power⁷². Jeremy Corbyn has also backed the creation of a shadow defence diversification agency in his Labour Party leadership campaign in 2015⁷³. The Labour Party does not yet have a specific policy on defence diversification.

The Scottish Nationalist Party (SNP) is opposed to the renewal of Trident and is in favour of nuclear disarmament. The SNP does not yet have any formal policy on defence diversification, however the SNP did say in the event of a vote in favour of Scottish Independence that they would not seek to close the Faslane naval base. An SNP Defence spokesperson Brendan O'Hara MP said in 2017 'Faslane has a bright, non-nuclear future as a conventional naval base for us and our allies and partners.'⁷⁵

The Liberal Democrat Party has stated its commitment to "keeping the Trident Successor Programme [the previous name for the Dreadnought programme] but ending continuous at-sea deterrence". Such a policy would not end the UK nuclear arms programme but might nevertheless have economic impacts⁷⁶. The Liberal Democrats do not yet have any formal policy on defence diversification.

The Green Party has opposed the replacement of Trident and is in favour of nuclear disarmament. It also has a formal policy backing arms conversion. Its policy reads: "The Green Party is committed to the early conversion of economic, scientific and technological resources presently used to support the arms race, to socially useful and productive ends. Some military training areas should be decommissioned and used as nature reserves, with suitable provision for access by the public.

An imaginative programme of arms conversion could use many of the skills and resources at present tied up in the military industry, to create new jobs and produce socially useful products. Conversion would also free research and development expertise and capital. New renewable energy industries, for instance, could be set up in the same area and use the same skills and resources as the existing arms industries e.g. wave power (shipbuilding), wind power (aerospace) and tidal power (power engineering).⁷⁷

The potential for diversification to 'green' industries is one that has gained particular support in recent years, and we explore some specific cases in the next section. However, it is worth giving a brief summary of the national situation at this point. The Office of National Statistics (ONS) has in the last few years

been publishing estimates of the level of UK employment in such green sectors. For example, it estimated that the ‘low carbon and renewable energy’ sector directly employed about 208,000 people in 2016, about 50% more than the defence sector.⁷⁸ There are numerous skills common to both these sectors, as we shall explore. Furthermore, the broader ‘environmental goods and services’ sector was estimated to have employed over 373,000 in 2014.⁷⁹ These sectors are set to expand further given the recent launch of the ‘UK Clean Growth Strategy’ and related programmes. Hence the potential for these sectors to take on those workers who might be made redundant by cuts in arms programmes – with retraining as necessary – is a realistic proposition.

Trade unions which represent arms industry workers have mixed views on both issues of Trident and defence diversification.

In 2006 the Trade Union Congress (TUC) General Council renewed its call for disarmament, though cautioned that the impact on employment should be considered. Then, as mentioned above, in 2017 the TUC passed a resolution calling on the Labour Party to establish a Shadow Defence Diversification Agency as part of the creation of a national industrial strategy including the possibility of conversion of defence capacity. The TUC’s proposal outlined a collaborative approach with workers and local authorities aiming to preserve both employment and pay levels⁸⁰.

Major unions such as Unite and the Public and Commercial Services Union (PCS) have backed the idea of diversification. Unite published a 2016 report calling for lessons to be learnt from overseas attempts at diversification and for legislation to impose a statutory duty on the Ministry of Defence and its suppliers to consider diversification, saying ‘Without legislation, history tells us that voluntary mechanisms do not work as defence companies are unwilling to take the risk of entering new or adjacent markets’. Unite has also called for public investment and financial support⁸¹.

The GMB, which represents many defence industry workers, has opposed defence diversification and campaigns opposing the replacement of Trident⁸².

Unite most notably has clearly linked the two issues of disarmament and diversification, struggling with their commitment to disarmament but being unwilling to advocate for any position that might cost their member’s jobs. In a 2016 statement by Unite’s Executive Council, they stated that:

‘Unite remains opposed in principle to the possession or deployment of nuclear weapons (including Trident) but our first duty remains to our members. Therefore, until there is a government in office ready, willing and able to give cast-iron guarantees on the security of the skilled work and all the employment involved, our priority must be to defend and secure our members’ employment. Unite commits to campaigning to secure a serious government approach to defence diversification, enabling Britain to play its part in nuclear disarmament and urges the Labour party to give the highest priority to this aspect in its considerations.’

Defence diversification and Trident

The UK Government estimated in 2017 that the Dreadnought submarine building programme would employ 6,000 people at its peak. At the time of writing, the number of people working directly on the programme is approximately 3,000. More than half of those are designers and engineers⁸³.

According to the Ministry of Defence (MoD), the current Trident programme supports 30,000 jobs⁸⁴. The government's 30,000 jobs figure is difficult to evaluate as a detailed breakdown of this estimate has not been made available. In particular, it is not clear if this is an estimate of both direct and indirect employment. The MoD has stated that this figure includes 6,800 civilian MoD and Royal Navy jobs at the Clyde naval base including contractors from Babcock, Lockheed Martin UK and Rolls-Royce. This figure is due to grow to 8,200 in the 2020s⁸⁵. The MoD has also stated that 520 civilian jobs are dependent on Trident at the Faslane and Coulport bases⁸⁶.

An assessment by Professor Keith Hartley in 2012 analysed the employment stemming from both the construction and in-service support of replacing Trident and calculated that 26,000 jobs could be supported. However, he warned that this was likely to be a high estimate and did not account for issues like improvements in labour productivity. He also cautioned that this is not the same figure as potential job losses in event of not replacing Trident as many companies would seek alternative markets or contracts, particularly in the supply chain. Direct job losses, he argued, would be more likely to affect BAE, Rolls Royce, AWE and Devonport⁸⁷.

A 2016 report by CND calculated that 11,520 direct civilian jobs are directly dependent on the Trident programme though it is difficult to say how many of these jobs would be lost should the Trident's replacement be cancelled and how quickly they would be lost⁸⁸. These figures it should be noted do not include supply chain jobs or other indirectly generated jobs.

This includes work at the main building site at the shipyard in Barrow-in-Furness, at Rosyth Dockyard where parts are made and at the Rolls-Royce plant at Derby where the nuclear reactors (for submarine propulsion) are made. Devonport would also likely be affected as it conducts substantial submarine maintenance work at present, as would HM Naval Base Clyde, from which the Trident submarine force operates. The warheads for Britain's nuclear weapons system are built, maintained and eventually decommissioned at the Atomic Weapons Establishment (AWE) in Berkshire. The warhead was designed, and the parts manufactured, at AWE Aldermaston, with the final assembly taking place at AWE Burghfield, along with ongoing maintenance and decommissioning.

These sites, together with the Trident submarine base on the Clyde, therefore would be likely to be hardest hit by any cuts to or cancellation of the Trident programme. Several, though not all, of these sites also have a particularly heavy dependence on the arms industry and have sometimes been accused of becoming a one company town. In addition, several of the private companies involved have become increasingly concentrated on defence work within their business portfolio.

BAE Systems at Barrow is a notable example of concentration on relatively few military products caused by long term dependence on government shipbuilding business. NET found in its 2012 report on Trident

and employment in Barrow that BAE Systems employed 5,046 people out of a total population of only 69,100 people⁸⁹. Professor Hartley's estimate of employment stemming from Trident replacement estimated 6,045 jobs at Barrow alone could be supported⁹⁰.

The Barrow shipyard was formerly owned by the Vickers company (VSEL) and Mort and Spinardi recorded in their history of the site that it had significant civil production alongside military production. "Once a highly diverse company with a broad range of profitable engineering interests, VSEL became almost entirely synonymous with shipbuilding, and particularly with the building of the Trident submarines. This level of defence dependence came about following a process of active marginalisation of non-defence work which created a monoculture within the company for the first time, and in which the perceived status of civil engineering declined in relation to 'superior' defence requirements."⁹¹

The very high level of military business dependence and the highly specialised technologies underlying the work on nuclear weapons and military submarines puts the work at Barrow and the other manufacturing centres for Trident into the 'most difficult' category of projects to diversify into civilian markets.

It is notable that military shipbuilding differs radically from civil shipbuilding and a study by the RAND corporation concluded that a move by the UK to re-enter the commercial shipbuilding market or enter the military ship export market would face "daunting challenges" including:

- The need for the country's militarily oriented shipbuilding industrial base to enter the dramatically different world of commercial shipbuilding;
- Strong competition in both markets;
- The mismatch between the United Kingdom's military ship products and the needs of importing countries.⁹²

In particular, commercial ships are on average three times the size of military vessels meaning they cannot be built in many military shipyards. Commercial vessels are technologically much simpler and require repetitive manufacturing techniques rather than complex systems being installed for military purposes. As a result of the technological complexity of warships the workforce of a military dockyard has a much higher proportion of white collar workers which make low-cost construction of commercial vessels in a competitive global market very difficult.⁹³

It should be noted that there has been a particular focus in the UK and elsewhere on the opportunities for arms production to diversify into green technologies. There have been some studies which have suggested there is a good crossover between military shipbuilding job skills and green technology job skills⁹⁴.

Campaign Against Arms Trade's "Arms to Renewables" study found evidence of substantial skill crossovers and some good geographic alignment in UK between current arms workers and possible green job possibilities such as offshore wind, wave and tidal energy generation⁹⁵.

Several of the site-specific studies conducted on the different sites most tied to Trident have shown substantial possible opportunities to diversify into green technology.

There are also many greater challenges to re-using nuclear weapons related facilities than typical military facilities. While decommissioning and cleaning up a former facility should of course be required regardless of its intended next use there are probably going to be difficulties in some forms of re-use of the facilities.

Environmental clean-up costs following use of nuclear materials can be vast and outweigh the value of the underlying land or facilities. Therefore, in the cases of former nuclear bases, abandoning the sites after decommissioning, or only using them in less intensive ways, may prove safer and better value.

The workers in the UK's nuclear arms industry have a very technologically advanced skillset. The skills of working with nuclear materials are especially desirable in the context of the civil nuclear industry and nuclear decommissioning work, although it should be noted that many of the economic and ethical concerns about the nuclear weapons sector also apply to the civil nuclear sector. Nevertheless, decommissioning of nuclear facilities is an area that will provide thousands of jobs for several decades, regardless of one's ethical views on the pros and cons of nuclear power.

Investigations by academics from Sussex University have also found evidence in defence policy discussions that the UK civil nuclear industry is being subsidised by government decisions in part to resource the UK nuclear weapons programme⁹⁶.

Any analysis of the potential crossover between workforces inevitably involves some simplification, there is usually for example a divide between the circumstances of more and less skilled workers. Some workers may be more able to move around the country or internationally while others may have either more transferrable skills or while being more expert they may become overly specialised.

However, the broader engineering and technological skills of many workers in the arms industry are in high demand. In 2010 the President of General Dynamics UK (also Vice President-Defence of the arms industry's trade association ADS) while attempting to argue in favour of higher arms spending, told the House of Commons Defence Committee that: '... the skills that might be divested of a reducing defence industry do not just sit there waiting to come back. They will be mopped up by other industries that need such skills. We are talking about high-level systems engineering skills, which are often described as hen's teeth. It is an area in which the country generally needs to invest more. You can think of the upsurge in nuclear and alternative energy as being two areas that would mop up those people almost immediately'.⁹⁷

Diversification prospects at Trident-related sites

Several studies and proposals focusing on the locations most likely to be affected by cancellation of the Trident programme have put forward opportunities for diversification at these sites.

A 2015 study by Campaign Against Arms Trade looked at the opportunities in the wave power industry for the estimated 6,000 arms industry workers in the Clyde region (which includes Faslane)⁹⁸. A 2007 study by Scottish CND and the Scottish TUC also identified renewables, including marine renewables as a potential growth industry in the region with comparable skills. A 2015 follow up report by the same groups and The West Dunbartonshire Economic Development Strategy 2011-16 also identified tourism as a potential alternative source of employment⁹⁹.

A 2016 report by the Nuclear Information Service on the history and future opportunities at the Atomic Weapons Establishment (AWE) found that “the prospects for a post-Trident AWE to move away from its current role into civil sector markets are good, and are compatible with regional economic development strategies’. In the event of the UK cancelling its future nuclear arms projects then ‘jobs and economic benefits at AWE need not be lost in the short to medium term and could be conserved in the long term by putting the Establishment’s assets and skills to work in pursuit of innovative new civil sector business opportunities’. Particular ideas put forward included creating a science park or a catapult centre for providing research and development services for business¹⁰⁰.

A 2016 report by CAG consultants, commissioned by the European Greens, analysed the opportunities for diversification into renewable energy in Devonport should Trident be cut. The report found estimates of 4000-4500 people employed for maintenance services for surface ship as well as submarine work and noted that the marine skills and facilities has already prompted Babcock Marine, the principal employer, to pursue renewable energy related contracts. New renewable energy jobs were also a far more immediate prospect than jobs from Trident replacement that would likely not reach Devonport until 2037¹⁰¹.

A 1987 report ‘Oceans of Work’, which had support from some of the trade union representatives from the shipyard, identified opportunities at Barrow in civil research, development, and production projects and particularly an offshore renewable energy programme, including wave and wind power systems. A follow up study in 2007 recorded that over 20 years 9,000 jobs had been lost while the shipyard concentrated on military production – three quarters of the 12,000 staff employed in 1987. The study suggested that Barrow could still successfully move away from military industrial work with government support and suggested developing and investing in alternative energy¹⁰².

More recently, a 2012 report by the Nuclear Education Trust (NET) found that whilst a decision to cancel the Successor submarine programme would potentially be ‘devastating’ for Barrow, with ‘sufficient political, financial and community commitment and advance planning’ the ‘diversification and regeneration’ required to save jobs and the local economy would be possible. The NET report identified a number of possible options for regeneration in the region from local initiatives to larger structural and infrastructural options. Natural synergies with the expertise and experience in the Barrow workforce were identified with advanced manufacturing, maritime, environmental and renewable technologies, particularly the tidal and wave energy markets¹⁰³.

The cost of these proposed diversification projects is debateable, especially given the relatively low level of funding required in the United States programme. Professor Steve Fothergill, the National Director of the Industrial Communities Alliance estimated that £100,000 would be required to create a replacement for every job lost in Barrow if the shipyard was to close, given the local circumstances. In other words, for every 1,000 employees lost a regeneration fund of £100 million would be required¹⁰⁴.

Conclusions

Norman Augustine, former CEO of Martin Marietta and retired chairman of its successor, military contracting giant Lockheed Martin, famously said in 1995 that the experience of defence contractors moving into civilian production ‘has a record unblemished by success’¹⁰⁵. Augustine was not correct: as the examples given above demonstrate, there are viable examples from around the world of companies and workers who have created new civil production opportunities. However, diversification is not a straightforward process and success is not guaranteed.

Even where diversification has deemed to be a success the costs of the reallocation of resources from military industry to civil production should not be understated. There is a real cost for workers and communities, especially where new economic activity cannot be created in the same location through an idealised plant-based conversion programme. Every international case study identified has involved substantial job losses in the short term.

On the other hand, economic transition always results in upheaval, and 'do nothing' is not an option. Trends in defence spending and markets show that employment in the defence manufacturing sector has already been in long-term decline. Diversification should not be portrayed as a manifesto to save every job but a tool to mitigate the impacts of change and provide opportunities.

In the UK, the challenge is not as insurmountable as some might expect. The UK arms industry now directly employs an estimated 142,000 people. According to CND only approximately 11,000 jobs are currently supported by Trident. The employment supported by replacing Trident meanwhile is estimated at between 26,000 and 30,000 with many of those jobs not appearing until after new submarines come into service in 2031. Compared to the level of funding required over lifetime of Trident’s replacement, estimated to be between £140bn and £205bn, this represents poor value for money when considered purely in terms of employment.

Cancelling Trident’s replacement does not inherently mean putting this number of people out of work but consideration could be given to the regions most heavily dependent on the UK arms industry. The costs of the international diversification programmes are tiny in contrast to the cost of Trident’s replacement.

From the ongoing nationwide community-led approach being piloted by the United States to historic post-Cold War examples in Bremen there are successes in diversifying and finding alternative employment for workers. Even in the instance of South Africa’s nuclear weapons programme being cut while apartheid fell there was success in mitigating the impact of cuts.

The UK’s inspirational case of the Lucas workers pushing for changing production for social good sets the tone for the thinking in the more recent detailed studies that have proposed specific options for sites that would be most affected by choosing not to replace Trident.

International experiences of diversification as well as experience in the UK from the Lucas Plan has shown that the best ideas and innovations often come from the workers and affected communities – but on their own, these are not enough for success. A broad partnership is needed to tackle the issues, and for

the best chance of success the arms companies themselves, national and local government, unions, civil society, academia and other stakeholders must fulfil their role in supporting workers and affected communities in making decisions for their future. This coalition must be given appropriate support in organising, analysis and planning as well as implementation.

There is a clear government interest in maintaining not just employment in general but in helping retain and develop the specific skill bases that exist in the defence industry. Several proposals for diversification have included science parks while in South Africa public sector arms industry workers were kept in the public sector, these options should be kept on the table when considering the arms industry workforce as a national asset.

A top-down approach of government intervention in the arms industry already exists with the UK government providing significant state support for R&D and export promotion. Some of these same resources could instead be spent on diversification efforts instead.

Government intervention and support is also shown to be essential to the success of diversification projects, notably in Bremen's case where state intervention was seen to overcome companies' institutional resistance to diversification in the event of uncertainty in both civil and military markets. An essential role of not just funding, but organisation, training and guidance appears to be being played by the Office of Economic Adjustment in the US diversification programme.

The UK has the foundation for a coalition of parties interested in diversification to emerge. There is long-running interest from civil society in the subject of defence diversification and there has been support from several unions as well as from Labour leader Jeremy Corbyn for a publicly-funded Defence Diversification Agency that could provide coordination, assistance and funding. The union Unite has further proposed imposing a statutory duty on the Ministry of Defence and its suppliers to consider diversification.

Factors attributed to determining the success of diversification are apparent in the learning from each of the case studies presented in this report. These common factors are listed below.

- Workers and communities must take the lead on making decisions for diversification, but a broad partnership involving all stakeholders is necessary for success.
- Political support for diversification must come from national, regional and local levels
- Action must be taken at early stages to proactively assist communities in diversification, rather than reacting to a crisis. Suggested timelines to organise and plan for diversification range from three to five years as a minimum.
- Funding must be available not just for putting a plan into action but for organising, analysing the situation, planning and then implementation. This should include regeneration funding to help new civilian industries relocate into a vulnerable area.
- Existing organisations, relationships and expertise must be identified and taken advantage of and efforts should be made to ease the transition into more competitive civil markets. Joint ventures and network learning should be encouraged.

There have already been positive suggestions for the approach that the Defence Diversification Agency could take with the Nuclear Information Service's 2016 report on the future of AWE sets out. 'The role of the Defence Diversification Agency should be as an enabler, setting out a high-level policy framework for diversification of the defence industrial sector into civil markets and providing funding to back schemes for transforming individual sites as part of devolved broader regional development programmes.'¹⁰⁶

The objectives of such an agency and the methodology it should apply, should be further developed.

About the author

Barnaby Pace writes, researches and campaigns on politics and security. His work has featured in the *SIPRI Yearbook*, the edited collection *African Muckraking*, published by Jacana Media, and *Offensive Insecurity*, published by Scientists for Global Responsibility. He was a primary researcher for *Shadow World: Inside the Global Arms Trade*, and holds a Master's Degree in Mechanical Engineering from the University of Warwick.

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List of Abbreviations

AEC – Atomic Energy Corporation
 AP – Structural Policy Action Program
 AWE – Atomic Weapons Establishment
 CAAT – Campaign Against Arms Trade
 CND – Campaign for Nuclear Disarmament
 CP – Bremen Industrial Defence Conversion Program
 CREC – Center for Regional Economic Competitiveness
 DDA – Defence Diversification Agency
 DERA – UK Defence Evaluation and Research Agency
 DIA – Defence Industrial Adjustment
 DOD – US Department of Defense
 DSTL – UK Defence Science and Technology Laboratory
 INES – International Network of Engineers and Scientists for Global Responsibility
 MoD – UK Ministry of Defence
 NIS – Nuclear Information Service
 NET – Nuclear Education Trust
 OEA – US Office of Economic Adjustment
 PTP – Pelindaba Technology Products
 SNP – Scottish Nationalist Party
 TUC – Trade Union Congress

Footnotes

- 1 ADS Group, 7/9/2017, “UK Defence Outlook 2017”, <https://www.adsgroup.org.uk/reports/uk-defence-outlook-report-2017/>
- 2 DASA, 2003, “Estimated UK Employment Dependent on Ministry Of Defence Expenditure and Defence Exports”
<http://webarchive.nationalarchives.gov.uk/20140116143358/http://www.dasa.mod.uk/publications/finance-and-economics/archive/defence-statistics-bulletins/defence-statistics-bulletin-number-05-expenditure-and-defence-export-1-march-2003.pdf>;
- 3 Throughout this report we shall use both the terms defence industry and arms industry. While “defence” is euphemistic and there are good reasons to avoid its use, it is difficult to avoid when it is widely used in discussions of the industry that we are drawing upon.
- 4 ADS Group, 7/9/2017, “UK Defence Outlook 2017”, <https://www.adsgroup.org.uk/reports/uk-defence-outlook-report-2017/>
- 5 DASA, 2003, “Estimated UK Employment Dependent on Ministry Of Defence Expenditure and Defence Exports”
<http://webarchive.nationalarchives.gov.uk/20140116143358/http://www.dasa.mod.uk/publications/finance-and-economics/archive/defence-statistics-bulletins/defence-statistics-bulletin-number-05-expenditure-and-defence-export-1-march-2003.pdf>;
- 6 Throughout this report we shall use both the terms defence industry and arms industry. While “defence” is euphemistic and there are good reasons to avoid its use, it is difficult to avoid when it is widely used in discussions of the industry that we are drawing upon.
- 7 UK Defence Statistics Bulletin, “Estimated UK Employment Dependent on Ministry Of Defence Expenditure and Defence Exports”
<http://webarchive.nationalarchives.gov.uk/20140116143358/http://www.dasa.mod.uk/publications/finance-and-economics/archive/defence-statistics-bulletins/defence-statistics-bulletin-number-05-expenditure-and-defence-export-1-march-2003.pdf>; Campaign Against Arms Trade, 10/2014, “Arms to Renewables”, <https://www.caat.org.uk/campaigns/arms-to-renewables/arms-to-renewables-background-briefing.pdf>
- 8 Inga Thorsson, 1984-1985, In Pursuit of Disarmament, Liber, Stockholm
- 9 Pollin R., Garrett-Peltier H. (2011). The U.S. Employment Effects of Military and Domestic Spending Priorities: 2011 update. Department of Economics and Political Economy Research Institute (PERI), University of Massachusetts-Amherst. December. http://www.peri.umass.edu/fileadmin/pdf/published_study/PERI_military_spending_2011.pdf
- 10 Southwood, 1991 “Disarming military industries”, Palgrave Macmillan, p4
- 11 Op. cit.
- 12 Lucas Aerospace Shop Steward Committee, “Corporate Plan”, p5,
<https://www.dropbox.com/s/o2sqxvhams2ywup/Lucas-Plan-53pp-alternative%20corporate%20plan.pdf?dl=0>
- 13 Red Pepper, 11/9/2015, “Bang on target: a brief union history of arms conversion”,
<https://www.redpepper.org.uk/bang-on-target-a-brief-union-history-of-arms-conversion/>
- 14 Red Pepper, 11/9/2015, “Bang on target: a brief union history of arms conversion”,
<https://www.redpepper.org.uk/bang-on-target-a-brief-union-history-of-arms-conversion/>
- 15 Department for Trade and Industry, 12/2003, “Innovation Report”,
<http://webarchive.nationalarchives.gov.uk/20070603164932/http://www.dti.gov.uk/files/file12093.pdf> p96
- 16 Select Committee on Defence, 7/6/2000 “Ninth Report”,
<https://publications.parliament.uk/pa/cm199900/cmselect/cmdfence/462/46202.htm>
- 17 Select Committee on Defence, 20/2/2007 “Eighth Report”,
<https://publications.parliament.uk/pa/cm200607/cmselect/cmdfence/84/8409.htm>
- 18 Select Committee on Defence, 8/5/2007, “Tenth Special Report”
<https://publications.parliament.uk/pa/cm200607/cmselect/cmdfence/512/51204.htm>
- 19 Campaign Against Arms Trade, “Government promotion”, <https://www.caat.org.uk/issues/govt-promotion/dit-dso>
- 20 Office of Economic Adjustment, undated, “Local official’s guide to Defence Industry Adjustment”,
<http://defensemap.org/wp-content/uploads/2016/03/2.-Local-Officials-Guide-to-Defense-Adjustment.pdf>
- 21 Office of Economic Adjustment, 2/2015, “Operation and Maintenance, Defense-Wide Fiscal Year (FY) 2016 Budget Estimates”,
http://comptroller.defense.gov/Portals/45/Documents/defbudget/fy2016/budget_justification/pdfs/01_Operation_and_Maintenance/O_M_VOL_1_PART_1/OEA_PB16.pdf
- 22 Office of Economic Adjustment, 2/2015, “Operation and Maintenance, Defense-Wide Fiscal Year (FY) 2016 Budget Estimates”,
http://comptroller.defense.gov/Portals/45/Documents/defbudget/fy2016/budget_justification/pdfs/01_Operation_

- and_Maintenance/O_M_VOL_1_PART_1/OEA_PB16.pdf
- 23 CREC, “Assessing and Evaluating the Defense Industry Adjustment Program”, <http://creconline.org/projects/assessing-and-evaluating-the-defense-industry-adjustment-program/>
 - 24 Office of Economic Adjustment, 2017, “2017 National Conference of Regions The Defense Department and Your Community”, http://narc.org/wp-content/uploads/Defense_Cyrena.pdf
 - 25 Office of Economic Adjustment website, “Grant Opportunities”, <https://web.archive.org/web/20170808192011/http://www.oea.gov/grants/grant-opportunities>
 - 26 Interview with CREC official
 - 27 Oklahoma State University, 13/5/2016 “OSUIT Launches Interactive Web Portal to Assist Businesses Impacted by Defense Cuts”, <https://osuit.edu/news/osuit-launches-interactive-web-portal-assist-businesses-impacted-defense-cuts>
 - 28 Office of Economic Adjustment website, “DIA Strategies”, <https://web.archive.org/web/20170418224340/http://www.oea.gov:80/how-we-do-it/defense-industry-adjustment/dia-strategies>
 - 29 Interview with CREC official
 - 30 Interview with CREC official
 - 31 Interview with CREC official
 - 32 Interview with CREC official
 - 33 The American Prospect, 2/3/2018, Miriam Pemberton, “The Little Agency That Could Have Tamed the Military-Industrial Complex”, <http://prospect.org/article/little-agency-could-have-tamed-military-industrial-complex>
 - 34 Perani, Conversion experiences and policies in Italy, Defence Conversion Strategies pp407-429
 - 35 Brommelhorster, 1999 KONVER II: Fostering of conversion by the European Union. Report 9. Bonn, BICC.
 - 36 Guilio Perani, Conversion experiences and policies in Italy, Defence Conversion Strategies pp407-429
 - 37 The Maastricht Treaty, creating the European Union, became effective from 1st November 1993.
 - 38 Commission of European Communities, 1992. The economic and social impact of reductions in defence spending and military forces on the regions of the Community, Brussels: Directorate General XVI
 - 39 Elsner, 1992, “Military reconversion and regional economic policy. The case of the state of Bremen (Germany)” Bremen Zeitschrift fuer Wirtschaftspolitik 15, pp201-210
 - 40 Elsner, 1996, “Konversion als Innovation”, Die Bremische Konversionsfoerderung
 - 41 John Accordino & Wolfram Elsner, 2000, “Conversion Planning in Two Military Shipbuilding Regions: Hampton Roads, Virginia and Bremen, Germany”, International Regional Science Review 23, 1: 48-65
 - 42 Bremen State Research Institute, 1991, “Diversification of the European Military Industry and the Tracing of Alternative Regional Initiatives to Energize Economic Development, Final Report”, Bremen Economic Policy Journal, No 3/ 4 pp203-229
 - 43 John Accordino & Wolfram Elsner, 2000, “Conversion Planning in Two Military Shipbuilding Regions: Hampton Roads, Virginia and Bremen, Germany”, International Regional Science Review 23, 1: 48-65
 - 44 John Accordino & Wolfram Elsner, 2000, “Conversion Planning in Two Military Shipbuilding Regions: Hampton Roads, Virginia and Bremen, Germany”, International Regional Science Review 23, 1: 48-65
 - 45 Bremen State Research Institute, 1991, “Diversification of the European Military Industry and the Tracing of Alternative Regional Initiatives to Energize Economic Development, Final Report”, Bremen Economic Policy Journal, No 3/ 4 pp203-229
 - 46 Wolfram Elsner “instruments and institutions of industrial policy at the regional level in Germany: The example of Industrial Defence Conversion”, Journal of Economic Issues, 29:2 (1995), pp 503-16
 - 47 John Accordino & Wolfram Elsner, 2000, “Conversion Planning in Two Military Shipbuilding Regions: Hampton Roads, Virginia and Bremen, Germany”, International Regional Science Review 23, 1: 48-65
 - 48 Defence Conversion Strategies, 1997, Josephine Stein, “Conversion at a Russian Dockyard in Estonia”, pp351-359
 - 49 Defence Conversion Strategies, 1997, Josephine Stein, “Conversion at a Russian Dockyard in Estonia”, pp351-359
 - 50 Larsson and Nilsson, 1992, “Conversion of Shipyard No. 7 in Tallinn, Estonia - Not only a military/civilian conversion”, Department of Industrial Management, Lund Institute of Technology
 - 51 Batchelor and Willett, 1998, Disarmament and Defence Industrial Adjustment: South Africa, p103, Oxford University Press
 - 52 Batchelor and Willett, 1998, Disarmament and Defence Industrial Adjustment: South Africa, p84, Oxford University Press
 - 53 Financial Mail, 22/6/1990, “Top Companies”
 - 54 Batchelor and Willett, 1998, Disarmament and Defence Industrial Adjustment: South Africa, p84, Oxford University Press
 - 55 Denel Annual Report, 1992/93, p10
 - 56 Batchelor and Willett, 1998, Disarmament and Defence Industrial Adjustment: South Africa, p84, Oxford

- University Press
- 57 Batchelor and Willett, 1998, *Disarmament and Defence Industrial Adjustment: South Africa*, p84, Oxford University Press
- 58 Business Day, 7/10/1993, p10
- 59 SALVO, vol. 2, 1993, p21
- 60 Enslin, General Manager, Advena quoted in Albright, D. “The legacy of the South African nuclear weapons program”, Paper presented at the Conference on a Nuclear Policy for a Democratic South Africa, Cape Town, 11-13 Feb, 1994, p.12
- 61 Denel Website, <http://www.denel.co.za/our-business/products--services>
- 62 Defence Statistics Bulletin, “Estimated UK Employment Dependent on Ministry Of Defence Expenditure and Defence Exports”
<http://webarchive.nationalarchives.gov.uk/20140116143358/http://www.dasa.mod.uk/publications/finance-and-economics/archive/defence-statistics-bulletins/defence-statistics-bulletin-number-05-expenditure-and-defence-export-1-march-2003.pdf>; Campaign Against Arms Trade, 10/2014, “Arms to Renewables”,
<https://www.caat.org.uk/campaigns/arms-to-renewables/arms-to-renewables-background-briefing.pdf>
- 63 BAE Systems, “What we do in the UK”, <https://www.baesystems.com/en-uk/what-we-do/what-we-do-in-the-uk/uk-key-facts>; SIPRI Arms Industry Database, “Data for the SIPRI Top 100 for 2002–16”,
<https://www.sipri.org/databases/armsindustry>
- 64 SIPRI Arms Industry Database, “Data for the SIPRI Top 100 for 2002–16”,
<https://www.sipri.org/databases/armsindustry>
- 65 <https://www.gov.uk/government/publications/defence-industrial-policy>
- 66 Financial Times, 6/9/2017, “BAE’s monopoly on naval shipbuilding faces more competition”,
<https://www.ft.com/content/a78d9ed6-925c-11e7-a9e6-11d2f0ebb7f0>
- 67 Financial Times, 28/8/2017, “Critics see hole in Royal Navy’s new shipbuilding strategy”,
<https://www.ft.com/content/00fbb148-8956-11e7-bf50-e1c239b45787>
- 68 Scientists for Global Responsibility, 2013, “Offensive Insecurity”,
www.sgr.org.uk/sites/sgr.org.uk/files/SGR_Offensive_Insecurity_%20full_report.pdf; Telegraph, 27/1/2017, “Alarm sounded over whether Britain can afford £178bn military spending plans”,
<https://www.telegraph.co.uk/business/2017/01/27/alarm-sounded-whether-britain-can-afford-178bn-military-spending/> and the Ministry of Defence Equipment Plan 2017 to 2027 from the National Audit Office 31/1/2018
<https://www.nao.org.uk/report/ministry-of-defence-the-equipment-plan-2017-to-2027/>
- 69 House of Commons Library briefing paper, 8/12/2017, “The cost of the UK’s strategic nuclear deterrent”,
<https://researchbriefings.parliament.uk/ResearchBriefing/Summary/CBP-8166>
- 70 CND, 18/7/2016, “The costs of replacing Trident”, <http://www.cnduk.org/about/item/download/288>
- 71 Conservative Party, 2017. “Forward Together: Manifesto 2017”, <https://www.conservatives.com/manifesto>
- 72 Guardian, 26/5/2017, “Corbyn refuses to back Trident but says he will respect Labour position”,
<https://www.theguardian.com/politics/2017/may/26/jeremy-corbyn-trident-labour-manifesto-commitment>
- 73 Jeremy Corbyn, 1/8/2015, “Defence Diversification”
<https://d3n8a8pro7vhmx.cloudfront.net/jeremyforlabour/pages/111/attachments/original/1439209889/DefenceDiversification.pdf?1439209889>
- 74 Scottish Nationalist Party Website, 3/3/2016, “Trident – what you need to know”,
https://www.snp.org/trident_what_you_need_to_know
- 75 The Herald, 17/3/2017, “SNP defence spokesman says Faslane has bright, non-nuclear future”,
http://www.heraldsotland.com/news/15164811.SNP_defence_spokesman_says_Faslane_has_bright__non_nuclear_future/
- 76 Liberal Democrat Website, 18/3/2017, “Lib Dems back credible minimum nuclear deterrent”,
<https://www.libdems.org.uk/libdems-back-credible-minimum-nuclear-deterrent>
- 77 Green Party Website, 2014, “Peace & Defence”, <https://policy.greenparty.org.uk/pd.html>
- 78 ONS (2018). UK environmental accounts: Low carbon and renewable energy economy survey, final estimates: 2016. <https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalesimates/2016>
- 79 ONS (2017). UK environmental goods and services sector (EGSS): 2010 to 2014.
<https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/ukenvironmentalaccounts/2010to2014>
- 80 TUC 2017 Conference, 2017, “Defence, jobs and diversification”, <https://congress.tuc.org.uk/motion-17-defence-jobs-and-diversification/#sthash.hbtCdU90.Vhqj8YKU.dpbs>
- 81 Unite, 5/2016, “Defence Diversification Revisited”, <http://www.unitetheunion.org/uploaded/documents/0041-Defence%20Diversification%20Revisited%20Brochure11-26072.pdf>
- 82 GMB, 13/9/2017, “GMB Very Disappointed as TUC Congress Carries Motion Undermining Union Members Jobs and National Defence”, <http://www.gmb.org.uk/newsroom/motion-undermines-defence-workers>

- 83 House of Commons Library briefing paper, 8/12/2017, “The cost of the UK’s strategic nuclear deterrent”, <https://researchbriefings.parliament.uk/ResearchBriefing/Summary/CBP-8166>
- 84 Hansard, 25/1/2016, “Trident Submarines: Employment: Written question – 23884”, <https://www.parliament.uk/business/publications/written-questions-answers-statements/written-question/Commons/2016-01-25/23884/>
- 85 Hansard, 25/1/2016, “Trident Submarines: Employment: Written question – 23884”, <https://www.parliament.uk/business/publications/written-questions-answers-statements/written-question/Commons/2016-01-25/23884/>
- 86 UK Defence Journal, 9/10/2017, “Fact Check: How many jobs depend on Faslane?”, <https://ukdefencejournal.org.uk/fact-check-many-jobs-depend-faslane/>
- 87 Keith Hartley, 2012, “Basic Trident Commission: Defence-Industrial Issues: Employment, Skills, Technology and Regional Impacts”, http://www.basicint.org/sites/default/files/trident_commission_defence-industrial_issues_keith_hartley_0.pdf
- 88 CND, 2016, “Trident and Jobs: The employment implications of cancelling Trident replacement” http://www.cnduk.org/images/stories/trident_and_jobs.pdf
- 89 Nuclear Education Trust, 12/2012, “Trident Alternatives Review and the future of Barrow”, http://www.nucleareducationtrust.org/images/stories/grant_reports/VOLUME_1.pdf
- 90 House of Commons Library briefing paper, 8/12/2017, “The cost of the UK’s strategic nuclear deterrent”, <https://researchbriefings.parliament.uk/ResearchBriefing/Summary/CBP-8166>
- 91 Business History, Mort & Spinardi, 2004, “Defence and the decline of UK mechanical engineering: the case of Vickers at Barrow”, Volume 46
- 92 RAND Corporation, 2005, “Diversifying the Customer Base for Shipbuilding in the United Kingdom”, https://www.rand.org/pubs/research_briefs/RB9117.html
- 93 RAND Corporation, 2005, “Differences Between Military and Commercial Shipbuilding: Implications for the United Kingdom’s Ministry of Defence”, <https://www.rand.org/pubs/monographs/MG236.html>
- 94 Pemberton, M. (2009). Military vs. Climate Security: Mapping the Shift from the Bush Years to the Obama Era. Institute for Policy Studies
- 95 CAAT, 10/2014, “Arms to Renewables”, <https://www.caat.org.uk/campaigns/arms-to-renewables/arms-to-renewables-background-briefing.pdf>; CAAT, 11/2015, “Arms Industry in the Clyde and renewable energy options”, <https://www.caat.org.uk/campaigns/arms-to-renewables/clyde-case-study.pdf>
- 96 Guardian, 12/10/2017, “Electricity consumers 'to fund nuclear weapons through Hinkley Point C'”, <https://www.theguardian.com/uk-news/2017/oct/12/electricity-consumers-to-fund-nuclear-weapons-through-hinkley-point-c>
- 97 Hansard (2010). Corrected transcript of oral evidence: House of Commons Defence Committee on The Strategic Defence and Security Review. 8 September. <http://www.publications.parliament.uk/pa/cm201011/cmselect/cmdfence/c451-i/c45101.htm>
- 98 Campaign Against Arms Trade, November 2015, Tim Jones, “Arms Industry in the Clyde & Renewable Energy Options”, <https://www.caat.org.uk/campaigns/arms-to-renewables/clyde-case-study.pdf>
- 99 STUC/SCND, 22/4/2015, “Trident and Jobs”, <http://www.stuc.org.uk/files/Congress%202015/DefenceDiversificationReport2014%20v2.pdf>
- 100 Nuclear Information Service, June 2016, “AWE: Britain’s Nuclear Weapons Factory; Past, present, and possibilities for the future”, <https://www.nuclearinfo.org/sites/default/files/AWE-Past%2C%20Present%2C%20Future%20Report%202016.pdf>
- 101 CAG Consultants, 10/2016, “Devonport: Trident alternatives”, http://mollymep.org.uk/wp-content/uploads/Devonport-report-CAG_FINALPDF-Sept2016.pdf
- 102 BASIC, Steven Schofield, 1/2007, “Oceans of work, arms conversion revisited”, http://www.basicint.org/sites/default/files/oceans_0.pdf
- 103 Nuclear Education Trust, 12/2012, “Trident Alternatives Review and the future of Barrow”, http://www.nucleareducationtrust.org/images/stories/grant_reports/VOLUME_1.pdf
- 104 Op. cit.
- 105 Washington Post, 1995, “A Conversation with Norman R. Augustine, chairman and chief executive of Lockheed Martin Corp.”, <http://www.washingtonpost.com/wp-srv/business/longterm/lockheed/augustine.htm>
- 106 Nuclear Information Service, June 2016, “AWE: Britain’s Nuclear Weapons Factory; Past, present, and possibilities for the future”, <https://www.nuclearinfo.org/sites/default/files/AWE-Past%2C%20Present%2C%20Future%20Report%202016.pdf>

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