

**PRODUCE AND SUSTAIN:
AN INDUSTRIAL BLUEPRINT FOR BRITAIN**

by
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The current post-Brexit offers by the Conservative and Labour parties are essentially for more *spending* priorities. There is not a word about what increased production is required to pay for them. The parties must be assuming that resources will be obtained by magic². Such assumptions have led us directly through and since the Brown years into the world's largest balance of trade in goods deficit, not remotely offset by net services and net foreign investment income.

1 BRITAIN URGENTLY NEEDS TO MAKE A BIGGER RANGE OF THINGS

In 1918, exactly 100 years ago, the then Government's Committee on Commercial and Industrial Policy reported (Cd 8462):

“It is our opinion a matter of vital importance that, alike in the old established industries, as well as the new branches of manufacture, both employer and employed should make every effort to attain the largest possible volume of production by the increased efficiency of industrial organisation and processes, by more intensive working, and by the adoption of the best and most economical methods of distribution.”

“It is only by the attainment of this maximum production and efficiency that we can hope to secure a speedy recovery of the industrial and financial position of the United Kingdom and assure its economic stability and progress.”

In a nutshell what the committee said is that what only really matters is the production of goods at the right quality, price and delivery to market (the QPD factors).

¹ See end of paper for a brief resumé.

² This is not to ignore the present Government's welcome “Industrial Strategy”, published 27th November 2017, and its “Faraday Challenge” fund (set up in June 2017).

Twenty years later in 1938, Lord Weir reported to the Defence Policy and Requirements Committee (DPRC) wrestling with the problems of rearmament, that “we in the UK are short of fundamental facilities for making certain articles”³. “The real bottleneck is skilled labour”. The most profound analysis of the state of British industry between the wars ever written⁴, records in excruciating detail the lack of capacity for making even the most commonplace of objects – typewriters, components for radios, clockwork mechanisms, let alone more complicated things for instrumentation, machine tools, radars. In 100 years, with the exception of the war years, nothing has really changed very much.

In the 25 years of the Single Market, with the full force of the huge range of EU exports unleashed on it, the UK goods deficit with the EU has therefore grown remorselessly from £5 billion in 1992 to £96 billion in 2016.

Whether we make a tariff-free trade agreement with the EU or simply withdraw in 12 months’ time and continue to trade with the non-EU world as we do now and with the EU on the tariff terms they have already lodged with the WTO (an average of less than 4% on the goods we send to the EU), will make very little difference in ten years’ time. What *will* make a massive difference is if we can use a big slice of the £725 million in the Government’s industrial strategy programme, matched by private funding, to get on with making a bigger RANGE of everyday things to supply more of our own home market from more factories, staffed by our own people, as well as achieving a bigger share of overseas markets (see Tables 1 and 2 below).

Should the UK leave without the EU agreeing to keep the zero tariff régime, the tariffs we would impose on EU imports to Britain (about £8 billion) would provide plenty of cash to reimburse R&D and market development costs to our exporters to the EU and other markets, all allowed by WTO rules under state aid for structural change.

1.1 At least halving our huge goods trade deficit is the UK’s first priority

We have a goods trade deficit of over £120 billion mostly with the EU. Eliminating, or at least substantially reducing that deficit, should be our first national priority. The £120 billion of

³ Cabinet Minutes 16/123 DPR(DR)1.

⁴ Correlli Barnett in “Collapse of British Power” published Eyre Methuen, London 1972, see especially pages 476-484.

goods not made in Britain means either that amount has to be borrowed from abroad, or British assets have to be sold for that amount to foreigners – every year.

At today’s manufacturing productivity, this deficit (6% of GDP – the largest of all the 34 OECD countries) corresponds to a loss of around a million skilled jobs not supplying the home market or the export markets.

Table 1 shows overall and with 3 examples, the terrifying extent which the UK retail and investment equipment market is currently supplied by imports and the corresponding shares of the UK market obtained by UK manufacturers.

Table 1: Import Penetration (2016) of UK Goods Markets for various product groups

Product Class ⁵	Sales by UK Manufacturers £M	Exports from UK £M	Imports into UK £M	Estimated UK Market £M	UK Share of UK Market
All manufacturing (SIC 10-32)	365,000	310,000	430,000	475,000	11.5%
Furniture (SIC 31)	6,700	2,630	4,100	8,200	50%
White Goods (SIC 27)	1,194	470	3,910	4,694	17%
Cars (SIC 29.1)	33,500	28,825	30,581	35,500	13.4%

Comment on Table 1

In the global market place, but with the advantage of common language, delivery, feedback from customers and ready provision of agents, one could expect home manufacturers to obtain around 50% of their own home market. Of major industries (> £1 billion sales) only furniture manufacturers and farming in the UK achieve this. The oldest industry, agriculture, actually has the highest share (60%) of its own UK market. Home manufacturers of cars (SIC 29.1) are often

⁵ SIC (2007): Standard Industrial Classification for comparing industries within and between countries and used by most national statistical offices to classify production at the 2 and 4 digit levels. SITC (rev. 3): Standard International Trade Classification is a UN classification for trade and customs purposes.

singled out as high performers, yet they achieve only 13-14%, i.e. one in seven cars as any observation of local car parks confirms.

Overall, UK manufacturers supply a pitiful 11.5% of their home market for manufactured products. This is by far the lowest figure of any significant OECD economy and leads straight to the *largest percentage goods trade deficit among all 35 OECD countries*.

This is not only economically threatening, it is literally dangerous for the security of our country.

In SIC category 26: computers, other electronic, electro therapeutic, and optical products, imports in 2016 were at £46 billion, over four times the total UK manufacturers' sales at £11 billion, 60% of which value will, typically, be imported components. SIC 26 is arguably the single most important category for military guns and vehicles, for military and civil avionics, medical scanning equipment, control and testing equipment of all kinds in hospitals, factories, transport systems.

With less than 10% of this market, there is no way with current forms of industrial organisation that domestic producers can possibly keep up in the face of a torrent of constantly improved designs from abroad. Our SIC category 26 product range and the manufacturers are just too small to provide what medium and big customers require and can obtain from overseas suppliers.

1.2 UK home market ignored by economists and journalists

Given the figures above, the UK is already the most open to foreign competition of all the large economies in the world. What we most urgently need is a long-term programme of industrial expansion based on a larger range of products, so trade deals lead to our products streaming out to foreign markets and not foreign goods streaming into our markets, which they already command to the extent of nearly 90%. Section 2 shows how it can be done.

One of the mysteries of economics and financial journalism is that increasing the UK share of the UK market is entirely ignored. The Treasury's so-called "model", which it uses to forecast our post-Brexit future far into the future, *has no allowance for the creation of entirely new manufacturing facilities*, with all that means for productivity, design of new products and skilled

jobs. Indeed “*because of Brexit*” the Treasury simply halves the current feeble annual increase in productivity and applies it to the next 15 years! Yet a £’s worth of product going to the UK market increases the GDP just as much as a £’s worth sold for export:

Table 1 shows the reason why the UK is in real danger in the current EU negotiations of paying too much for freedom to do trade deals. Yes, they are important at the 0.1-0.3% GDP level, but this is about one tenth of that obtained from doubling the UK’s share of its own market (see Table 2: £475 billion) to around 23%, still well below that of Germany or France.

The USA’s 44% constant price increase in exports to the EU, contrasting with the UK’s 8% and Switzerland’s 64% in the period (1992-2015, see Paper 6, Figure 2) was achieved without benefit of trade agreements, because their goods are priced, marketed and delivered competitively. We need to do the same.

1.3 Exaggeration of effects of a new tariff regime on manufacturers, including Japanese car-makers

As has been observed repeatedly in the past⁶, what businessmen, particularly corporate businessmen, crave is stability. Japanese business people are no exception: they are ultra conservative by nature and training.

If Japanese cars, for instance were actually faced with a 9.9% tariff into the EU post B-Day, they would be told by their owners in Japan to do two things:

- (i) Lower their ex-UK prices to compensate. After all they have had a 15% devaluation advantage from Q2-Q4 in 2017.
- (ii) Reassess the UK market for new models and components they could make in the UK. They will find plenty of support for this under the Leopard Programme (see below 3.2), financed by the tariffs collected on car imports from abroad.

⁶ Stephen Bush, “Britain’s Future: Business, Industry, and a New Relationship with the European Union, published Prosyma Research Ltd, 1997, ISBN 0 9517 47525, downloadable from the page “Performance of the Economy” on <http://britain-watch.co.uk>.

The Japanese owners, however, will be extremely well-placed to make a formal complaint to the WTO against the EU for any steps to apply tariffs to their UK goods. They would be in direct contravention of the undertaking which the EU trade commissioner, Karel de Gucht, made at the conclusion of the last WTO conference on tariff *reduction* at Doha in 2012. Import penetration of the UK car market is 85% (see Table 1 above) so any fall in the Japanese share of EU markets (why should there be?) can be more than offset by expanding their product range – taking further advantage of the move to hybrid and electric only cars which is gathering momentum right now.

1.4 UK Market is the biggest opportunity for UK Manufacturers

Eighty-five percent of all cars sold in the UK, over 90% of all consumer electronics, over 80% of white goods, 90% of key medical equipment, are supplied by foreign manufacturers (see comment on Table 1 above). The average import penetration over all of UK goods markets, excluding agricultural products is about 88% with some vital product categories above 90% as noted above. This is the highest of any of the G20 countries. Apart from a mild dip in 2009 at the depth of the recession, the country went on gaily importing, so the trade gap widened remorselessly – as it has continued to do – right up to 2017 Q4⁷.

For 70 years Government ministers, economists and financial journalists, in extolling the virtues of exports, have totally ignored the fact that while foreign markets are vital, the UK retail and investment goods market is about £475 billion (2016), by far the greatest opportunity for UK manufacturers to design, produce and sell more products, right on their doorsteps.

But to continue to make things we have to sell things and that depends absolutely on cultivating markets. Table 2 sets out an estimate of realistic targets for overseas markets and the UK Home Market over the 15 years 2020-35 (BRD, page 54 Table 3.1).

⁷ Cars and part imports rose by two thirds in the 10 years to 2017 for instance.

Table 2: UK Existing (2014) and UK Target Shares in Key Goods Markets (2020-35)

Area	Market \$ bn p.a.	UK Share %	Target Share %	Value of Increase \$ bn p.a.
EU 26-ROI**	5550	3.7*	4.5	33
AICANZ	2340	4.1	5.5	26
EFTA	305	4.6	6.0	4
BRIC	2770	1.3	2.6	36
GHSS***	956	3.7	5.0	13
TIM****	779	0.8	3.0	17
Total Imports of these groups	12700	3.7	4.7	\$129 bn = £92 bn
UK Home	720	11.5	23	\$81 bn = £58 bn

* Allowing for the "Rotterdam Effect" (ONS 2015 Q1).

** This is the EU goods market after the UK has left, minus the Irish Republic, which is really part of the AICANZ group of Anglo countries. Croatia is omitted from the EU list because it joined only in July 2014; Canada-US treated as one import market

*** Gulf, Hong Kong, Singapore, South Africa - group with a common business inheritance.

**** TIM: Turkey, Indonesia, Mexico

At just over 10% of GDP, the UK's ability to supply itself with modern consumer goods, military equipment, medical equipment, machinery to make those things, is at a critical point. In each of these product areas there are things we simply don't make any more. When asked recently why Germany's exports to China were six times those of the UK, a senior Chinese official simply said, "You don't have enough things to sell".

Meeting the home and overseas targets in Table 2 allowing for non-UK content, would add about 4% to GDP over a 15-year period, create a million skilled jobs and permanently increase our national productivity. But how can it be done?

2 PRODUCE AND SUSTAIN: THE NEW NORM

2.1 Regaining lost markets

To allow us back in to lost markets we must develop new products or at least variants of existing models. Here the outstanding opportunity is to take advantage of the new emphasis on sustainability, not just in Britain, but across the whole Western World. In goods terms this means requiring in post-Brexit Britain that all goods for sale are designed to be recuperable (see 2.2 for examples):

either

(a) by reprocessing of materials used in manufacture

or

(b) recovering components for re-use

or

(c) being easily maintainable

and setting standards for UK factories' products and foreign imports to adhere to. These developments will be hugely popular with young and old alike. People want to see and handle British products once more. Products in all Standard Industrial Classifications, including those examples in Table 1 will, over time, need to be redesigned to meet recuperation targets. Therein lies the opportunity to recapture lost markets at home and those to be obtained overseas as summarised in Table 2. If implemented, the Produce and Sustain programme will be much more popular than privatisation, being both "Green" and "Job-creating" for all.

2.2 Recuperative Design: A key to recovering lost markets

Sustainability is an ill-defined word which appears now in many if not most official documents. One easy-to-appreciate aspect is "recuperation" or recovery in some sense of materials used in manufactured artefacts. Engineers have always been concerned to minimise the financial costs of their designs, but minimising costs in a broader sense – environmental and social – are now often mandated by legislation and in public procurement.

Attention is shifting to avoiding single-use products and where that is unavoidable (in food packaging for example) to finding ways of recovering the materials used in some form, or failing that the energy used to make them. In line with a particular usage in the process industries⁸, we have termed the generality of such procedures “recuperation”. In future these will be built into product design from the beginning and not as after-thoughts. A list of recuperative designs includes:

- Reprocessing of used thermo-plastic materials by melting and remoulding.
- Recycling of refurbished components, e.g. re-tread tyres, some metal products.
- Recovery of precious metals from integrated circuits (difficult).
- Repair and maintenance of motor vehicles (recuperative design can make this much easier now).
- Recovery of heat in electricity generation as seen in modern gas-fired power stations.

And so on. Much recycling is already being done, but what should be different in future is that product design will see recuperation as a necessity. Obviously, pricing will have to reflect this.

2.3 Brains, Energy and Determination needed across the nation

The huge trade in goods deficit will not be redressed *just* by supporting research into new products in biotech or aerospace fields, important as these are. The big markets in the world and in the UK are the things which people use every day. And there is the most amazing opportunity post Brexit to reduce these huge deficits – not necessarily to zero – halving them would be enough to increase our GDP by £40 billion (2% GDP growth) over the 15 years, as estimated from Table 2. A huge prize awaits our people – especially in the former manufacturing districts of the North of England, Scotland, and also East Coast towns, as we recover our fishing rights and rebuild our ship-building industry on the back of this (section 3.6).

Overall to obtain this prize will require about 0.5 million into manufacturing, an increase of about 17% on present numbers (2.9 million), and a comparable number in related services. It will require the sort of single-minded national determination last seen in 1940-44, when the equipment needs of our armed forces were put ahead of every other national consideration, except actually fighting our enemies. If we achieve this turn-around, everything will be better:

⁸ Chemicals, polymers, food, nuclear power, cement, steel, non-ferrous metals; electricity, oil and gas.

more ships, planes and troops for the armed forces, more and better equipment for the NHS, more manufacturing industries in general, more pay for people, more British products in the shops.

2.4 British Industry is Internationally Competitive in parts – there is just not enough of it

Of the three sectors of the UK economy (industry, private services, public services), industry is the biggest exporter, having the highest productivity, but since the mid-1980s, has had by far the lowest number of employees. This is a poor distribution of labour when output per manufacturing person compares favourably with that of Germany: the average added value per person in UK manufacturing being £57,500 in 2014 compared with that of Germany (£56,900)⁹.

2.5 Production is King

For manufactures scale of production is the most important factor in terms of increasing competitiveness: by reducing the cost of production and generating new products through “learning”, while product range is the most important factor in covering different geographical and demographic markets. Both of these translate directly into home and export sales. If instead of £4,300, Britain’s manufacturing exports per head of the population were £5,500 (i.e. still only two thirds of Germany’s), and its sales to the Home market had similarly increased, the UK goods deficit of £120 billion would be eliminated and a million jobs would have been created (Table 2).

Scale of production today is of vital importance for production tomorrow, because it provides finance and direction for research and design today.

2.5 Britain Consumes Too Much and Invests Too Little

How can one advanced country expect to compete with another advanced country when it invests only two thirds of a smaller GDP in new equipment?

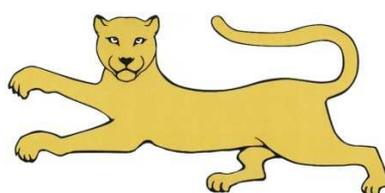
⁹ Over the 25-year period of the Single Market, Britain’s employment in manufacturing has actually decreased by 33%, while its employment in distribution, one of the lowest for productivity, has increased by 10%.

Table 3: Disposal of GDP: UK and Germany compared

Sector	UK (2014) % GDP	Germany (2014) % GDP
Investment	13.5	17.0
Private Consumption	70.0	57.0
Public Expenditure	<u>19.0</u>	<u>19.0</u>
Total spent in home market	102.5	93.0
Exports – Imports net	(2.5)	7.0
	100.0	100.0

Britain has lost world market share fundamentally because, while what industry it has is good on average, and some in aero-engines and pharmaceuticals is very good, there has simply not been enough investment in new productive assets across the board¹⁰. Britain's industrial army, like the British army, is just too small for the demands placed upon it. Table 3 shows how the UK uses its GDP compared with Germany's use of its GDP, which is in any case about 40% bigger¹¹. The next section sets out a proposal for a new form of manufacturing organisation (Leopard Companies) designed to make a 20% step increase in constant price investment in productive assets over a 15-year period, and a 17% increase in skilled labour.

3 NEW FORMS OF MANUFACTURING ORGANISATION: LEOPARD¹² COMPANIES



It is doubtful if the £92 billion per annum target for additional goods exports (Table 2) or £58 billion of additional home sales over a fifteen-twenty year period, could be achieved organically from existing forms of enterprise, which, as we have seen, have resisted well over 100 years of

¹⁰ Only about 10% of the investment claimed in Table 3 is for *production of goods*. Housing is classed as investment in National Statistics.

¹¹ Statistics sourced in ONS for UK; Statistische Bundesamt for Germany.

¹² LEOPARD is the acronym for **LE**aping on **O**pportunities **P**resented by **A**dvances in **R**ecuperative **D**esign.

attempts to prod them into arresting the comparative decline of UK industry. Expansion can only be done by the creation of new business structures involving both new and existing firms. This conclusion recognises the fact that innovating entirely new products and processes has only about a third the return of investment in “improving” what already exists¹³. Here “improvement” covers not just the manufacturing processes and products, but the product *range*. This means much more market feedback from overseas markets (in which the commercial sections of the British embassies must play an increasing part), and from the home market (in which the big retail chains must play a major part).

Leaping on the opportunities which new Trade Agreements with other countries will offer, will require a major effort of national will and a commitment of national pride. There will need to be product and process development with existing firms as well as new ones. In-depth marketing abroad, and training of a wide range of skills at home (not least language skills for the target markets) will need to be brought to bear, industry by industry, with the single-minded objective of producing more *things*¹⁴ for sale at home and abroad.

Constructing the new manufacturing capacity is outlined in the next section. Government support for manufacturing industries, notably the car industry in the 1970s, has got a bad reputation: sloppy management, poor industrial relations, poor designs, marketing, and quality. The proposed new financial and working structures have been designed to avoid these dire features, but at the end of the day, success will depend on the quality of the people involved.

3.1 Financial Structure of the Leopard Organisation

The financial structure (Figure 1) recognises the fact that only a systematic investment of major funds over a 20 year period will reverse the 150 year relative decline in the manufacture of goods and the machinery to make them^{15,16,17}. This decline was only reversed temporarily in the war years 1940-45 by Government-financed factory construction.

¹³ The German phrase is “immer besser”. See Gregor Davidson “The Competitiveness of UK Industry and the role of Innovation”, MPhil Thesis, Manchester University, 2004 for a comparison of the returns from Improvement and Innovation.

¹⁴ This is not to exclude soft-ware packages as long as they have repeat sales.

¹⁵ Ref 3, Correlli Barnett, pages 475-495.

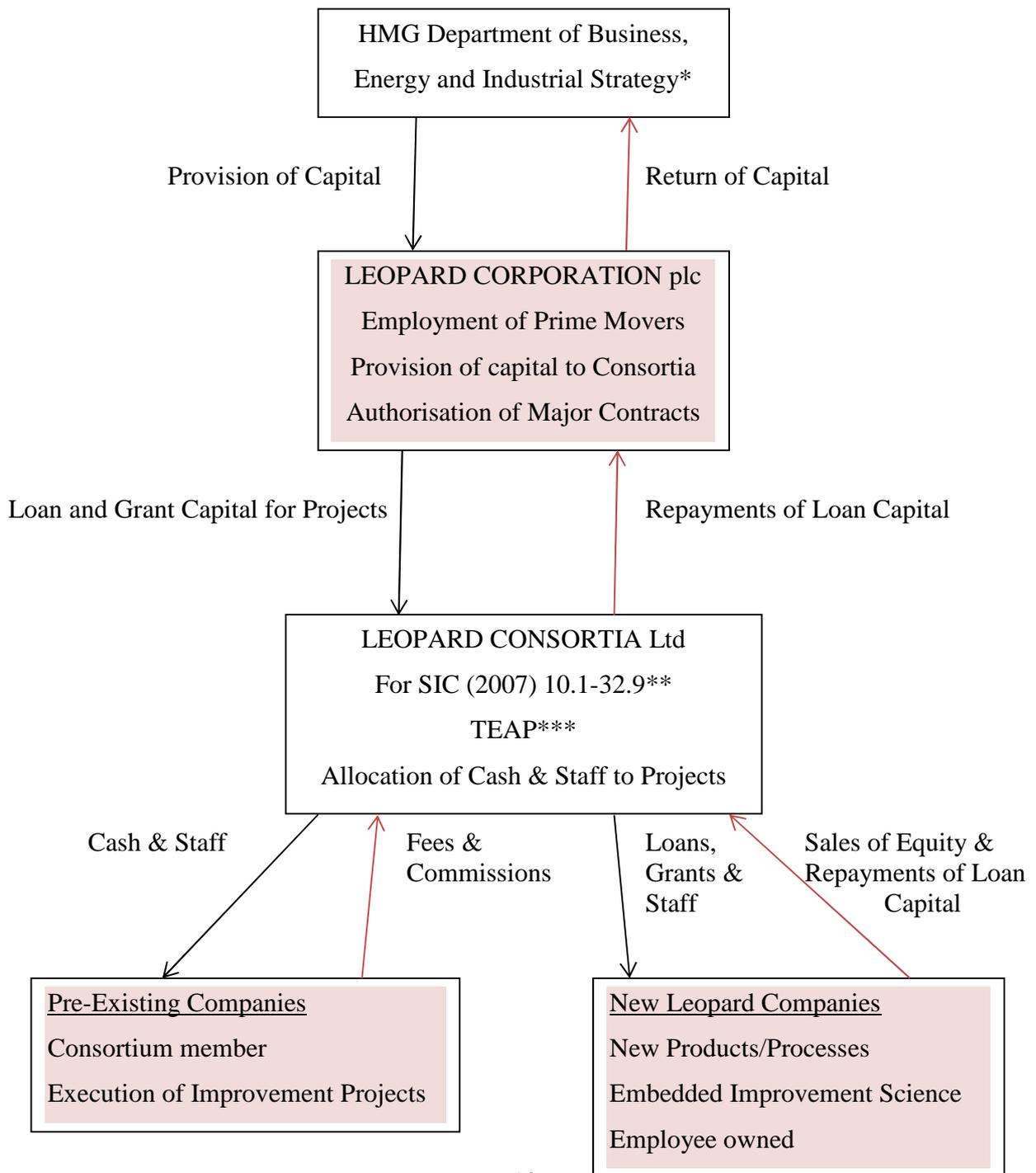
¹⁶ Sidney Pollard, “Development of the British Economy”, 1914-92, pages 427-30.

¹⁷ Stephen Bush Technomica Paper 6: Figures 1 and 2.

The financial objective of the Leopard programme is to reverse this decline by meeting the home and overseas sales targets in Table 2 above. Something like £50 billion will be needed over 20 years, of which about 70% would be 15-30 year loan capital returnable to the investor and 30% as a mix of non-returnable grants to the participating companies, including the new Leopard companies, and equity acquired by employees in those companies.

Figure 1

LEOPARD: Proposed Financial Structure – first 20 years



*BEIS is responsible for the Government’s “Industrial Strategy” and deployment of its £720 million budget.

** SIC (2007): Latest version of the Standard Industrial Classification, as established by the United Nations.

*** TEAP: Techno Economic Assessment of (proposed) Projects.

Of British registered companies, probably only the two oil majors BP and Shell, could comfortably invest this sort of money over the period and in any case this would be way out of their field.

This leaves the British government as the principal source of capital in the early years, though at a later stage the financial structure could be altered to bring in private investors like insurance companies and pension funds committed to the long-term.¹⁸

Having said this, it is noted that the British government has committed to spending £56 billion to build a high-speed rail link from London to Manchester via Birmingham with the vague justification of improving business links. By contrast, Leopard offers tightly specified programmes to be realised in small steps, but ultimately to create, over a 20-year period, half a million actual manufacturing jobs, solve the balance of payments problem, and put many more British products into the shops and showrooms.

3.2 How the Leopard Programme will work

As shown in Figure 1, the Leopard Programme for Industrial Renewal (LPIR) as envisaged here, consists of four basic elements:

1. Leopard Corporation plc

Responsible for the whole programme

2. Leopard Consortia Ltd

There will in principle be at least one consortium for each of the 23 SIC categories. Each will be responsible for:

¹⁸ The Government’s “Industrial Strategy” announced on November 27th 2017 is costed at £750 million over a 3-5 year period, and could be the source of Leopard capital in the early years.

- TEAP
The techno-economic assessment of manufacturing projects and the allocation of cash and staff to approved projects.
- Setting up marketing operations with the participating companies, especially for overseas markets, with British embassies abroad.
- Employing “prime movers”, proven engineering and/or scientific managers, and providing them to both pre-existing and new Leopard companies.
- Acting as a main focus for the Scientific Improvement Programmes (SIP) in their own SIC (Standard Industrial Classification).

3. Pre-existing Companies

Making products in their particular SICs and wishing to extend their range, increase production, and improve their processing.

4. New Leopard Companies

Formed specifically, on the co-ownership principle, to design and make products initially for those British SICs, where foreign imports account for more than 80% of sales.

Grants will be made for equipment up to pilot production. Long-term (10-30 years) low interest loans for full-scale production, once approved by the Consortium management.

Individual Leopard consortia would be hosted either by particular firms with an established manufacturing presence in the UK domestic market, or by university-based centres with a track-record of practical assistance to production companies in a relevant SIC. The host company must have a well-articulated ambition to expand either “horizontally” into a wider product range or “vertically” into its supply chain. Like the university centres, they would be paid for their “host” role, depending on the facilities and staff time committed. They would be eligible to participate in a SIP in their own right.

3.3 Leopard People

To achieve the increased sales targets set out in Table 2, worth over 20 years £92 billion abroad and £58 billion at home, will require around 17% increase in present UK manufacturing staff of 2.9 million. i.e. 0.5 million. They will be deployed mainly in the production companies as described in section 3.2 (3 and 4), and a small but important number will be needed in the Consortia themselves.

Staff will be recruited from two sources: (a) prime movers - experienced staff from existing industrial companies at home and abroad, (b) new graduates and apprentices. The objective will be that everyone engaged on a Leopard project – operators, technicians, engineers, managers, will have a recognised certificate of skills and knowledge relevant to their project, and share their companies' ambitions to grow through:

- a) Scientific Improvement of their existing processes and product range.
- b) Designing new products and processes to win market share at home and abroad, using the latest manufacturing and control methods, including recuperative design (2.2 above).

Leopard consortia will be incorporated as limited liability companies with shares held by member companies and financed by grants and loan capital from various sources, guaranteed by the Government. The emphasis on (a) and (b) will help build the case for exemption from WTO state aid restrictions.

Staff seconded or transferred into existing Consortium member companies for a maximum of 3 years on a Leopard Industrial Renewal Project (LIRP) will be paid by the relevant Leopard Consortium, with the option of transferring into the company if both company and individual agree.

Staff setting up a Leopard Company will be paid by the relevant SIC Leopard consortium for a maximum of 5 years, after which time they will be given the opportunity to acquire shares in the new company at a nominal price, the Government (BIS) retaining a golden share to prevent unwanted takeovers. It is envisaged that the shares acquired by employees will constitute a

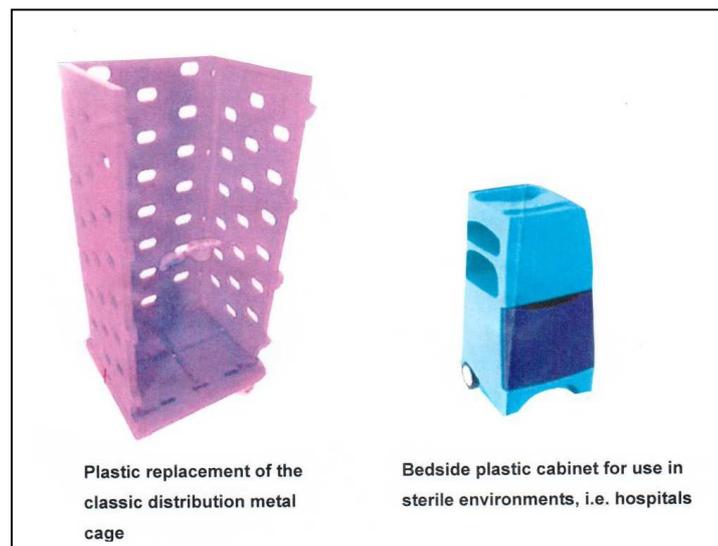
majority of the voting share-holding, thereby making a reality of co-ownership, restricting purely financial investors like hedge-funds¹⁹ to non-voting investment.

3.4 A prototype Leopard Consortium: NEPPCO

NEPPCO Ltd, originally the North of England Plastics Processing Consortium was set up in 1990 by this writer and two owner managers in the plastics industry (SIC 22). The Consortium's host was the University of Manchester Institute of Science and Technology.

Two examples of products which made it right through to commercialisation (Rollet and Biokab), from two different firms in the Consortium, one pre-existing, one brand new, are illustrated in Figure 2. The products have the same basic technology (rotomoulding of fully-recuperable polyethylene), but very different markets – retail and health respectively.

Figure 2



As there was only one consortium of this type in the country, there was no Leopard-type corporation (Figure 1), no Leopard companies set up and no loan capital. Cash came through the DTI (forerunner of today's Department of BIS – see Figure 1) and the European Regional Development Fund (ERDF). UMIST Staff and 3rd year engineering students were fed into the member companies to carry out improvement projects for periods generally of less than a year.

¹⁹ The Mondragon Corporation of the Basque province of Spain has grown from 5 prime-movers in 1956 to 74,000 in 2016 on just this principle.

These partial secondments were almost always satisfactory to both the companies and the staff/students.

The Consortium's mission was to increase the business by the application and development of the science of process manufacture. By 2000, there were 65 member companies (mostly SMEs) with 3,000 employees and a combined turnover of £220 million. In 10 years from founding, some 190 proposals had passed through the TEAP process (Figure 1) from which 6 new products, 3 new processes and 20 Leopard improvement projects went into production.

Although the work involved the actual production process equipment and staff, there were no "state aid" restrictions encountered, as it was always seen, in effect, as an experimental activity, albeit on the plant itself.

3.5 The role of retail in Britain's Industrial Regeneration

The largest part of Britain's home market (£475 billion) is retail sales to the public. The major retailers, therefore, have a huge part to play in Britain's industrial regeneration. A walk around any of the chain stores reveals few British-made products on their shelves, apart from toiletries (SIC 21) and furniture (SIC 31) as noted in table 1. Clothing is almost totally absent.

Up to the early 1990s the well-known retailer, Marks & Spencer Ltd, in effect ran a "vertical" Leopard Consortium of textile suppliers and their suppliers, to which it offered expert guidance in all parts of the production cycle. Of key importance were the 3-year purchasing contracts which it used to offer its first-tier suppliers. This allowed them to offer 3-year contracts to *their* suppliers, and so on. Perhaps 20-30 non-completing firms were involved in a substantial way. The standard reasons for the near total absence of British-made goods on their shelves *now* are (a) no British suppliers and (b) Far East goods are too price competitive owing to very low labour costs.

All that we can ask is that the retailers revisit the issue of costs and availability of at least some part of their offering. Looking at Italy in particular, modern manufacture and information technology, coupled with fashion and variety, have between them revolutionised availability. Building long-term relationships between designers, manufacturers and retailers, as Marks & Spencer used to do, through the Leopard model, could provide huge benefit to all parties. To

meet the home sales target in Table 2, we are only looking for a doubling of British manufacturing's tiny share of its home market (Table 1).

3.6 Capital Goods

Besides consumer goods, there are two capital goods Leopards urgently needed (the first predominantly “horizontal” and the other “vertical”).

(a) Shipbuilding

Rebuilding our trawler building industry to provide new boats for a target UK catch in 2030 of 3 times the present, would have a truly rejuvenating effect on some of our Coastal towns.

Moreover fishing vessel construction offers a way back into civil ship construction generally, of which we have very little.

One shipbuilding consortium with two Leopard clusters in two coastal towns offers the financial scale to get started. The aim would be to achieve a programme over 5 years of six 50-70 metre vessels. Shipbuilding staff would be employed on the terms given above. Perhaps Appledore Shipbuilders of North Devon (recently offered for sale by Babcock Marine) could be regenerated as a shipbuilding consortium host. Appledore has recently built sponsons for the new Queen Elizabeth and Prince of Wales aircraft carriers and is currently completing the fourth in a sequence of 90 metre patrol boats for the Irish Naval Service.

(b) Nuclear Leopards

Nuclear policy is a hotly debated field and the sums of money involved are huge. The construction of two reactors at Hinckley Point in Somerset looks like costing around £20 billion, or around £6 billion per GigaWatt capacity, which needs to be compared with £0.8 billion for new gas, or £4 billion for offshore wind.

For sustainability reasons alone Hinckley should be the last PWR type ever built: all Britain's nuclear effort should (a) be focussed in the here and now on the supply chain of equipment and (b) bringing forward “Fast Breeder” designs to recuperate our existing huge stock of unspent plutonium.

A Leopard to design and manufacture the quite commonplace components of a nuclear-based electricity generator like Hinckley would be of great value to general mechanical and chemical engineering industries, and if formed, rapidly taken up by existing firms as well as leading to new companies with substantial exports.

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After Cambridge and the Massachusetts Institute of Technology, Stephen Bush joined Imperial Chemical Industries as a Technical Officer, later serving for 11 years as Group Manager for ICI in the United Kingdom and on the European Continent.

In 2012 with his friend and colleague, David MacDonald, he won the Hanson Medal of the Institution of Chemical Engineers for their paper on energy policy and in 2014 he was a finalist in the Institute of Economic Affairs' prize for a "Brexit Blueprint". In 2016, just before the Referendum, Stephen Bush published under the Technomica label the book "Britain's Referendum Decision and its Effects", 266 pages, which has continued as a widely referred to authority, available on Amazon and downloadable at <http://stephenbush.net>.