(When) Can Europe Match US' Military Power?

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Abstract:

The Atlantic defence technology gap is substantial and appears to be growing in spite of an apparent political desire to close it. This paper estimates that the US stock of usable military equipment for modern warfare is about five to ten times larger than Europe's. The US military industrial machine is comparably highly efficient; Key indicators show progressive larger gaps compared to Europe the closer one gets to the battlefield. US defence budgets are only about 60 % higher than that of the European nations. The US lead on military investment is about 120 %, its military R&D beats Europe by 240 % resulting in a battlefield "advantage" of more than 480%. A System Dynamics simulation model is built to explore policies for closing this battlefield technology gap. In a base case scenario, this Atlantic divide continues to grow. Three policy tests are then run: First EU defence budgets are increased to US levels; then EU transforms its forces to expeditionary non-conscription units; last European military industry is consolidated combined with a tripling of R&D efforts. Neither policy is successful alone, yet with all three policies combined, the gap is significantly reduced and in about twenty-five years almost closed. The likelihood of such a combined aggressive European defence policy is discussed. It is argued that since the EU favours a softer security strategy, it will not want to bear the combined policy's high economic and political cost. Consequently, the EU will (have to) be content filling the western world's soft power niche.

Key words: Technology, society, politics, defence, policy analysis

The Atlantic Defence Technology Gap.

Numerous documents and authors have recently addressed the Atlantic defence technology gap (ADTG) (Economist, 2003). It appears that Europe is too slow to transform its forces into the light weight, capable high-tech forces required for today's and tomorrow's security challenges. Instead Europe is stuck with forces tailor made to counter an invasion from the east – almost fifteen years after the collapse of the Warsaw pact and its threat.

There is no common definition of ADTG. Frequently, ADTG is invoked to argue for a shake-up of the mostly inefficient and state-owned, nationally protected, European defence industry (EU, 2003; Köhle, 2001). Others are concerned with the fact that the European equipment stock is very old and hence antiquated and ineffective. Others again are concerned with US military might and that western involvement in conflict theatres are first filled with US men and weapons during the war-fighting stage and eventually fills up with European men in the later policing phase, when the Americans bring their advanced weaponry back home (Economist, 2004). This paper is concerned with this last issue; the battlefield technology gap: This lack of modern weaponry strongly confines the security policy options of European policy makers (whether this is good or bad is an important, but very different discussion).

Though there is no discussion of the ADTG's existence (NATO, 2002; EU, 2003) few venture into estimates of even its approximate size. Reasonable assumptions, used below, however estimate that the EU[1] battle relevant inventory only is 10 to 20 % of the US'. This estimate assumes that US and UK used a similar proportion of their total forces in the 2003 Iraqi war and that the total weapon use are reflected in Wahl et al. (2004) as shown in table 1 below. The estimate furthermore assumes that France could have replaced UK in that war with a similar force, or that the rest of Europe could have, also. Thus, the 1/23 (768/18101) capability fraction of UK/US indicated in table 1 translates into a 3/23 fraction for the EU as a whole. The EU stock of battle relevant equipment thus equals 13 % of the US'.

	US	UK
Tomahawk	802	?
CALCM CM	153	0
Storm Shadow CM	0	27
Laserguided bombs	8618	263
Laser and GPS bombs	98	392
JDAM (GPS bombs)	6542	0
Maverick missles	918	39
Hellfire missiles	562	0
Radar homing missiles	408	47
Advanced weapons, total	18101	768

Table 1: Advanced military hardware on both sides of the Atlantic, uses in the Iraqi war (Wahl 2004). Note that for Tomahawk cruise missiles, the UK figure is classified. The total here assumes 0, but UK Tomahawks were highly probable in use. The conclusions are however robust to the uncertainty in UK Tomahawk numbers.

What are the reasons behind this low fraction of EU/US weaponry? In order to address this question, Porter's (1980) value chain is invoked below in Diagram 1; an industrial value chain contains a stream of R&D that transforms into Industrial Capacity that again enables the manufacture of Consumer Products. Superimposed on this chain lies the Defence Capability value chain. This chain partly lives its own "life," partly it reflects the larger Industrial society's chain.

Reflecting society's chain, Defence R&D transforms into Defence Industrial Capacity. However, Defence R&D is strongly linked to the ambient society's R&D community. Similarly, the Defence R&D is also linked to a ambient market's Industrial infrastructure and know-how. However, the Defence to society industrial

[1] In this paper, "EU", "NATO Europe" and "Europe" are used interchangeably.

link appears weaker than the R&D link.[2] Defence Capability to some extent reflects consumer products, but this link is weaker still[3] (SPRU, 1996).

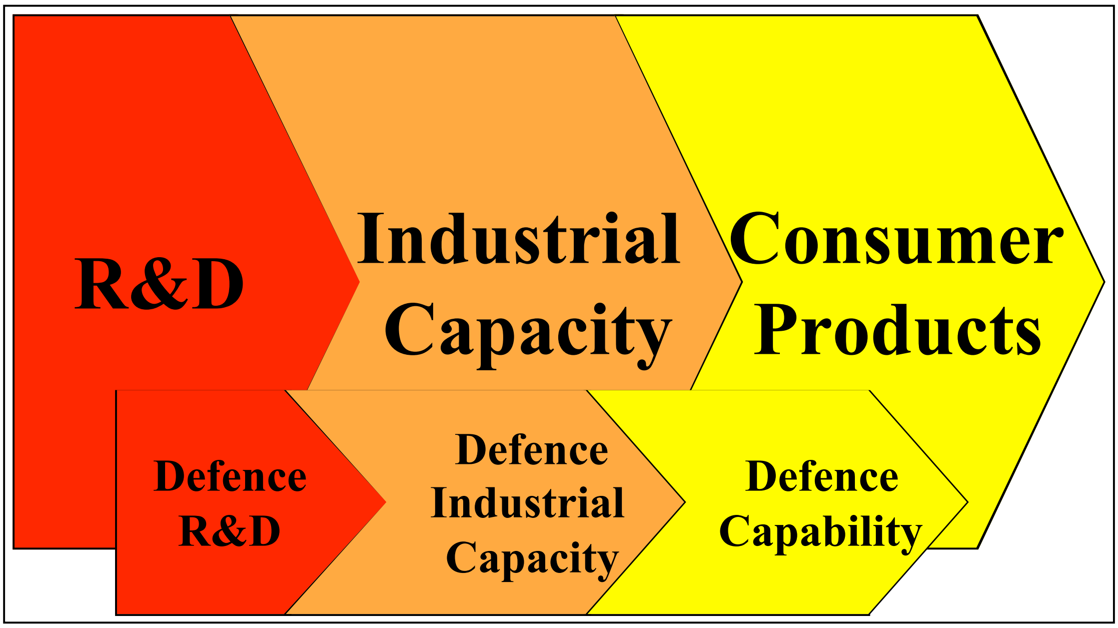
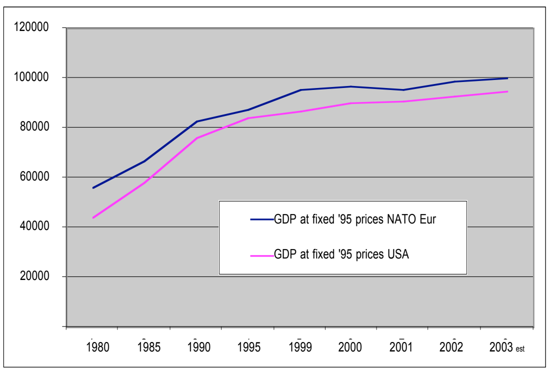
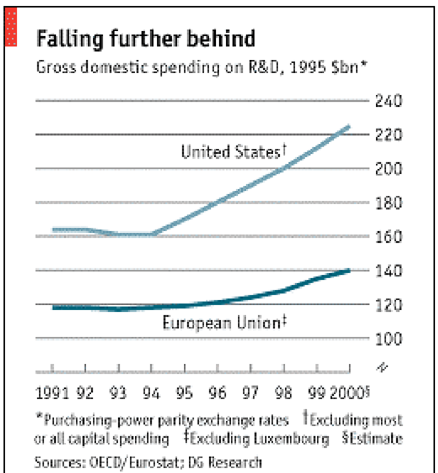


Diagram 1. The defence industrial value chain superimposed on the societal industrial value chain.

Figure 1 indicates that though Gross National Product (a proxy of Industrial Capacity) of US and Europe are quite similar, but figure 2 suggests the US is as a more advanced economy. Though Europe is the world leader in many consumer technology domains, such as passenger cars and wireless communication, it appears reasonable to say that the US economy on average is more advanced. One important reason (or consequence?) behind the US more advanced state is its stronger Research and development (R&D) base. This means that the US economy "shields" parts of its production from immediate consumption, and develops things that hopefully will be integrated into future products, making them more advanced than otherwise.





[2] For simplicity, this society to Defence Industrial link is omitted in the further modelling and simulation work, while the R&D link is maintained.
[3] This link is also omitted in the following modelling.

Figure 1: GDP in constant ´95 bill. USD historical, for EU and the US (NATO, 2002)

Figure 2: R&D, historical, for EU and the US (OECD, 1999)

Figure 2 shows that from 1991 to 2000, the US has increased its total (not only defence) R&D spending by about 50 % to 230 $ billion – much more than its GNP growth. The EU has increased its R&D by only 15 % to a mere 140 $ billion – notably less than its GNP growth. This means that European economies became less R&D intense in this interval.

It must be noted, however, that R&D here cover all aspects of R&D. If one includes only natural sciences and engineering, arguably more directly relevant to Industrial Capacity, then the US position is stronger than indicated here as a larger proportion of US R&D is devoted to natural science and engineering (OECD, 1999). US Defence R&D[4] is furthermore much more a corporate phenomenon than European R&D, which tends to be done in government laboratories[5].

As to data for the Defence value chain figure 3 indicates that the general 60-70 % US R&D advantage found in figure 2 is much stronger in the Defence field: The US outspends the EU fourfold in Defence R&D.

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[4] Most US Defence R&D is paid by the government, but performed by non-government universities and defence laboratories. In Europe, with the exception of the UK, government Defence R&D is mostly done in government laboratories (OECD, 1999)

[5] An indication that public R&D appears less effective than private is the fact that recently the British labour party government privatised 3/4 of its Defence Research and Evaluation Agency and 10000 civil servants became private sector employees (SDR, 1998).

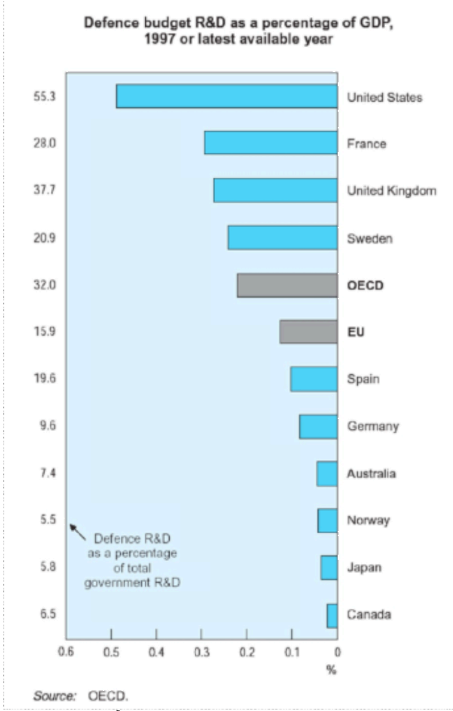

Figure 3[6]: R&D as % of GDP, for selected states (OECD, 1999)

As an illustration, it is often noted that the US military R&D dwarfs the entire defence budget of Europe's dominating economy: Germany. Similarly, the US DARPA (Defence Advanced Research Agency) outspends Norway's total defence budget.

The US is not only a more R&D based economy, most notably in the defence field, but also has a very different defence budget structure. Figure 4 below implies e.g. added income to the US defence industry as the US spends about 25 % of its budget on investment, compared to only 17 % average in Europe. In itself, this means that for each Defence dollar spent, the US buys 50 % more weapons.

[6] Figure 3 moreover shows the three divisions in military capabilities. First there is the US, spending over 0.5 % of GDP on defence R&D. This amounts to over half of its government R&D. In the second league are the two other nuclear weapon states France and the UK. They also share long stories of expeditionary warfare and capabilities and they spend more of government R&D on defence than on any other category. The third league is the rest of NATO Europe which spends very little.

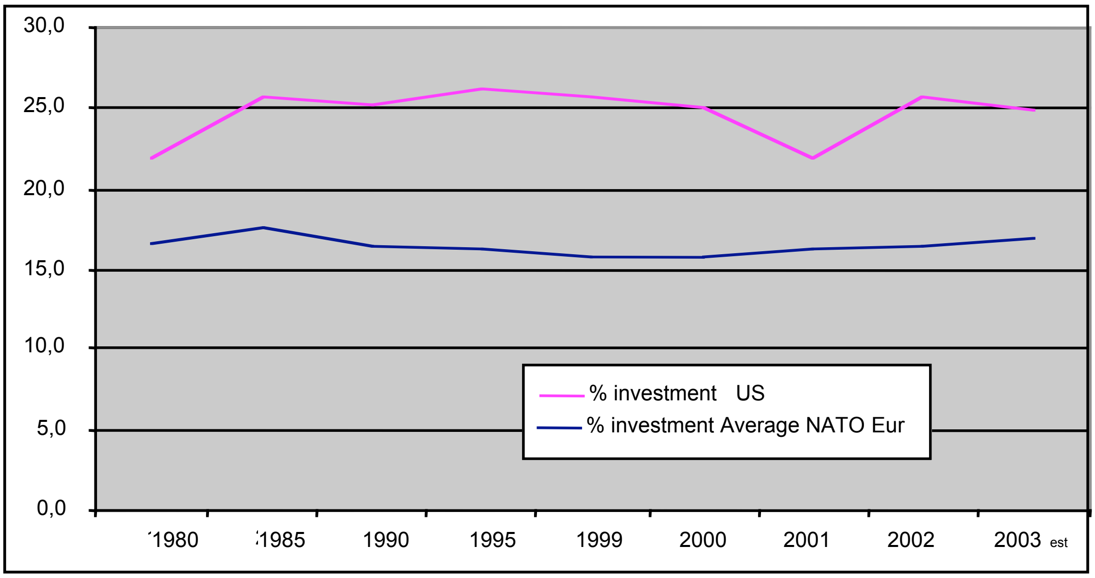

Figure 4: Fraction of US and EU defence budgets used for equipment purchase (NATO, 2002)

The budget comparisons above all underestimate the ADTG, on at least three accounts however.[7] First, the shock treatment when US defence budgets were cut in half over ten years from 1985 to 1995 forced a restructuring of the US industry (Gholz and Sapolsky, 1999). In Europe, there was less of an effect of the "peace dividend" on industry structure as Europe's defence industry was largely government owned and hence less dynamic (Küchle, 2001), and because the defence budget cuts were less severe in Europe (see figure 5 below). As the boom years for the US defence industry of post 1995 materialized, the industry had become more productive (Gholz and Sapolsky, 1999). This made it possible for the US to obtain more advanced weapons for each investment dollar spent. Secondly, the combination of higher US procurement budgets, a more consolidated industry, and a definite single US defence market (the EU one is still highly fragmented) also affords the US taxpayers a more capable defence than their European counterparts. Finally, defence procurement is increasingly tied to a "revolution in military affairs" (Williams and Lind, 1999). This revolution has implied leaps in the use of computers for various communication and processing needs. In this area, there is less difference between military and civilian technology. As the US has a stronger computer and software industry than does the EU, this has afforded the Americans a further advantage over the Europeans.

Figure 5 below shows the dramatic drop in defence priority on both sides of the Atlantic over the last 25 years. While in the US it has dropped from over 6 to about 3 percent of GDP, the NATO European nations dropped from about to 3 to about 2 percent of GDP. Over the last ten years, this percentage has remained largely stable on both sides of the Atlantic, but inched upwards in the US and downwards in Europe.

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[7] The following discussion is built on the reasonable assumptions that Europe's defence industry mostly equips Europe and the US equips its own forces.

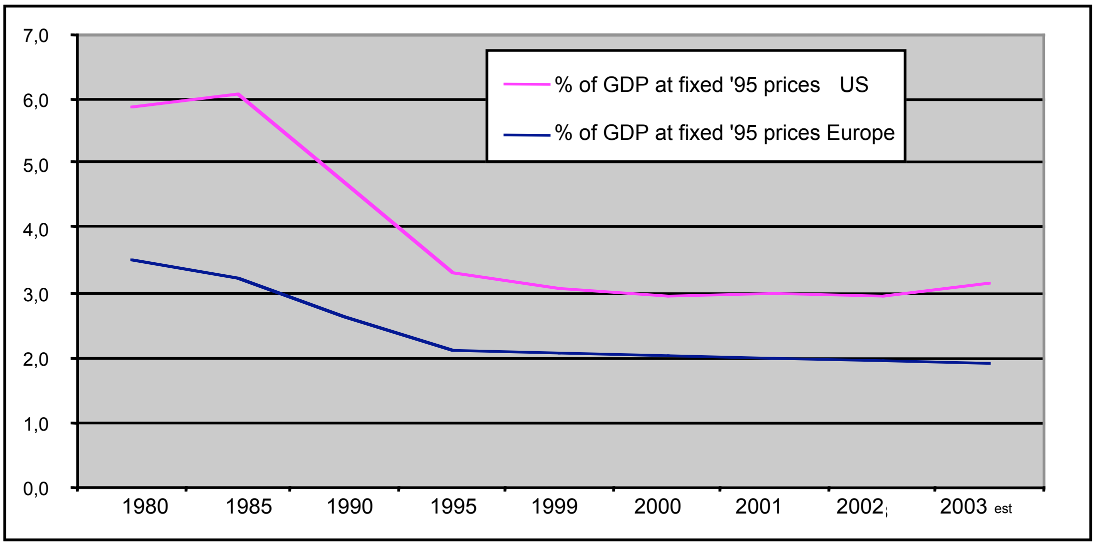

Figure 5: Defence expenditures % of GDP, for NATO Europe and the US. (NATO, 2002).

Combining figure 1 and figure 5 gives us figure 6. Today, the US defence budget is about 60 % higher than Europe's consolidated budget.

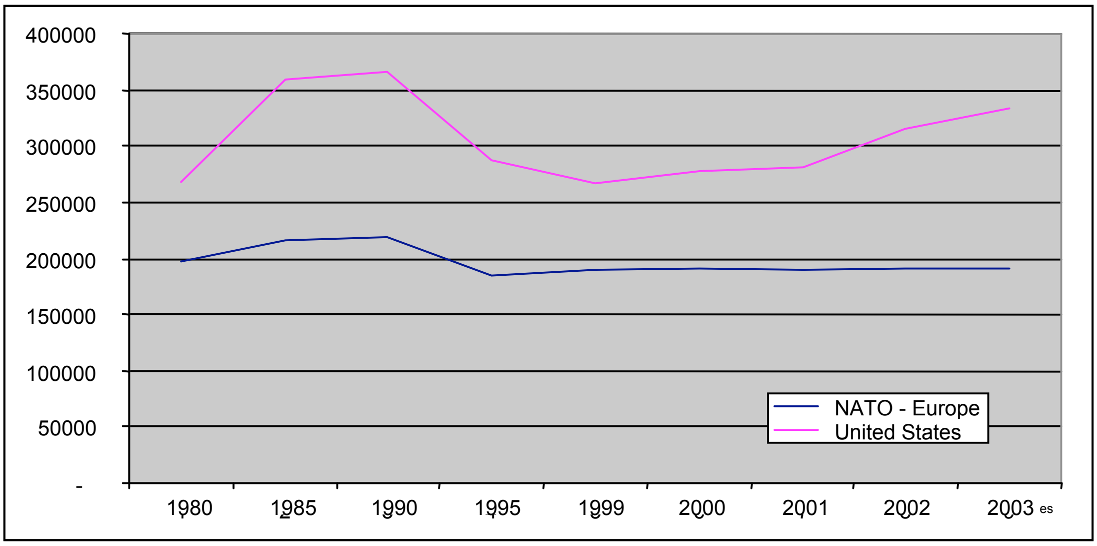

Figure 6: Defence expenditures, for NATO Europe and the US. 1995 USD million (NATO, 2002).

In summing up, the US military supremacy is fuelled by a powerful economy and a tradition of high defence spending and a willingness to sacrifice manpower for military hardware. The US outspends continental Europe (barring France, the exception) by a factor of more than ten in terms of R&D. Even allowing UK and France into the NATO Europe equation, the US military R&D spending is about four times higher in the US.

Policy issues

There exists a defence capabilities gap where the US probably has five to ten times more inventory of advanced fielded weapons systems: In terms of ability and willingness to project military power around the world, the US totally overshadows Europe. There are many reasons behind this. The US and Europeans[8] have different propensities to use military power; as an example the EU[9] was designed as a tool to prevent wars from re-emerging through tighter economic coupling between previous belligerents. In the US, wars are by many, especially the current administration, considered necessary evils to achieve desirable objectives (Albright, 2003). EU's stronger scepticism towards the use of military power contributes strongly to the fact that the combined EU defence budgets are less than 60 % of that of the US (Albright, 2003).

Yet, EU nations within NATO and outside have agreed that their forces are poorly fit for the tasks at hand (EU 2003); they still largely reflect cold war defence challenges and should change more rapidly. Moreover, the European nations do not get what they could for their Euros in terms of defence value. Consequently, NATO nations have all states a need to transform their defence forces into more usable capabilities, but few predict that European states will increase their defence budgets in the future (Economist, 2004).

The contradiction in EU stated objectives of military transformation and a (compared to the US) 35 % shortfall in budgets and 80 to 90 % shortfall in modern equipment, shows an ambiguity in European thinking (Economist, 2003). On the one hand European heads of states sign NATO documents stressing the need to modernize and develop, produce and field more advanced and cost-effective hardware. On the other hand, the underlying security doctrines across the Atlantic makes it less problematic for Europeans than for Americans to equip their more manpower intensive forces foremost with simple and/or outdated equipment that is (or at least was) suited for homeland defence against an invasion from the east. As evidenced by popular protests against the US led Iraqi invasion in 2003 and by an Atlantic divide between the top political leaders, Europeans favour UN and multilateral arrangements, whereas US is more prone to "go it alone" (Albright, 2003). - The US subscribes to a strategy that may be termed pre-emptive implying a stronger willingness to strike with full military power.

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[8] For simplicity, Europe, EU and NATO Europe are used interchangeably throughout this paper.

[9] In many ways, UK and France share US' security logic and have long histories of expeditionary operations. Their defence R&D labs and industries are much stronger than found elsewhere in Europe. Also industrially, UK and France are militarily strong and can be termed US "little sisters". The rest of Europe can be termed "midgets" in this regard. This paper lumps all of Europe together, but France and the UK corresponds less well to this implied stereotype of Europe than the rest of the continent.

Though some question the need to close the technology gap, or even care that it is growing, many European discussants (EU, 2003) argue that the world would be a more stable place if US military power dominance were to be less pronounced. Yet, policy options as to how to close the technology gap are rarely discussed in a concerted fashion. Though NATO strategies try to push nations towards e.g. higher defence spending (NATO, 2002), industrial restructuring and substituting manpower with technology, such policies are –with the exception of budget increases-, rarely compared or quantified. To take the few economics analysis of the issue (EU, 2003; Küchle, 2001), they tend to omit the system feedbacks in place. As will be discussed later, reinforcing feedbacks e.g. trap manpower intensive forces into a "low technology, low investment, policy."

Second, I have found no explicit modelling of the real human resources that develop, manufacture, operate and procure equipment. Such modelling is required in order to understand how the trajectory of technology gap responds to various policy options, especially to take account of realistic time delays. Consequently, this paper uses two frameworks, that of System Dynamics (Forrester, 1961; Sterman, 2000) and the resource based view (Wernerfelt, 1984; Hamel and Pralad, 1994). These two frameworks have been brought together by Morecroft (1998) and Warren (2002) in corporate strategy work. The common application of the two frameworks in a global security discussion appears lacking, however. Though this paper's aim is primarily applied, its methodological contribution is the dual framework application to the question of how to develop military power.

This paper will address the technology gap from the assumption that there exist an optimal defence mix of men and weapons, and a similar optimum mix of weapons that all states want to attain. It also assumes that Europe is seriously concerned with the fact that its weapons inventory is sub-optimal and poorly suited for the tasks that exist today and probably will in the future.

The rest of this paper is organized in the following way: Based on the data and the value chain in the introduction above, a causal loop diagram is designed. This diagram forms the basis of a simulation model that is then developed. Later, four policy tests are run. The last chapter discusses the likelihood that the suggested European policy will be implemented.

Causal loop diagram

A causal loop diagram (CLD) purports to show plausible causal mechanisms behind the issue at hand (in this case, the ADTG's persistence over time) taking into account overt and notably less obvious information feedback (Forrester, 1961; Sterman, 2000).

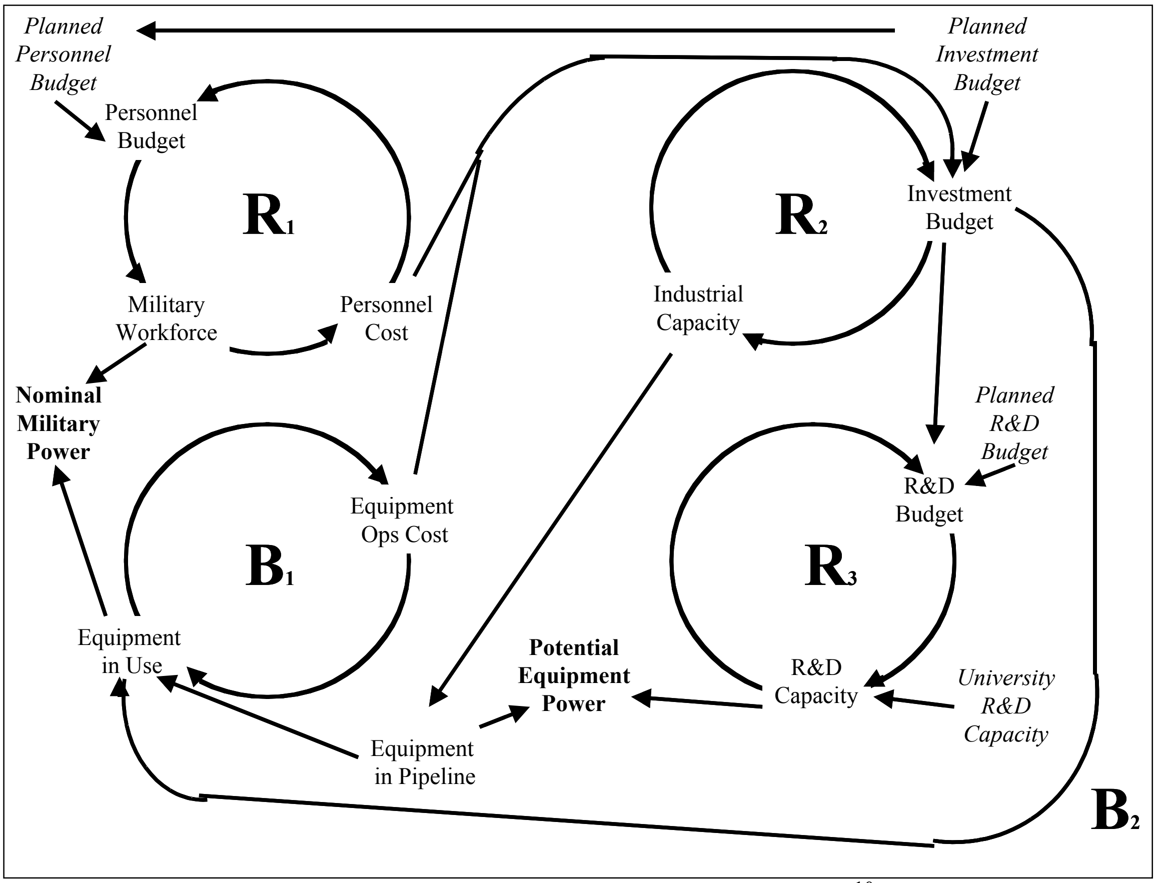


Diagram 1: CLD explaining the time trajectory of military power.[10] The same diagram individually explains the EU and the US.

The CLD has three self-reinforcing processes (R1, R2 and R3). These all state the anchoring part of and "anchoring and adjustment – heuristic (Sterman, 2000)". They all indicate the same mechanisms; higher the capacity and the larger the work force, the higher the funding of military men, the industrial capacity (i.e. men) men and R&D capacity (i.e. men). Stated differently, these loops explain the momentum of current policies. If one e.g. starts off with a large military work force, this momentum drives first personnel costs and later personnel budgets, higher.

The CLD also assumes a planning hierarchy where investment and R&D spending is decided in concert first, and personnel budgets are planned accordingly. This corresponds to a recent survey of NATO nation's long-term defence planning methods (Bakken, 2002).

The CLD assumes that total annual Defence budget is exogenous. This implies that the sum of the budgets for military manning, equipment operations; purchase and R&D is constant (B1). The within-year balancing of this zero-sum happens in two ways. First as equipment cost increases, equipment use is reduced (Tisdahl, 2004) mostly through less intensive service, but also through prolongation of new equipment

[10] The three self-reinforcing loops (R1, R2 and R3) all assume that "Capacity" is derived from the total work force and their average experience in the respective sectors, but are not shown here to maintain clarity. Several balancing feedback mechanisms in the budgeting process are similarly omitted in this diagram.

deliveries. Second, added operations costs change (invariably reduce) the actual investment budget from that planned (B2).

Simulation analysis

It was decided to investigate three different policies that are often proposed in Europe to close the Atlantic technology gap (Economist 2003 and 2004):

1. **Industrial policy:** Consolidate European defence industry, and at the same time increase the ambient (non-defence) R&D sector size[11]and level by a factor of three [at no cost to the Defence Sector]. Constant defence budgets.
2. **Budget policy:** Bring European annual defence spending up to US levels; i.e. by 60 % (in 25 years).
3. **Defence policy:** Convert Europe's huge, poorly trained largely conscript forces to professional ones. Constant defence budgets.

The Causal loop diagram was then redesigned and turned into a simulation model. The model is shown in appendix. Two variables were used to indicate various aspects of military technology:

1. *New equipment power:* Applies the current applied technology frontier (TF) to the amount of defence hardware in the ordering pipeline. It thus is an indicator of the quantity and quality of equipment **about to be operational**. This indicator thus also includes how much hardware has been ordered over the preceding five years (which is assumed to be the [exponential] average gestation time for such hardware).

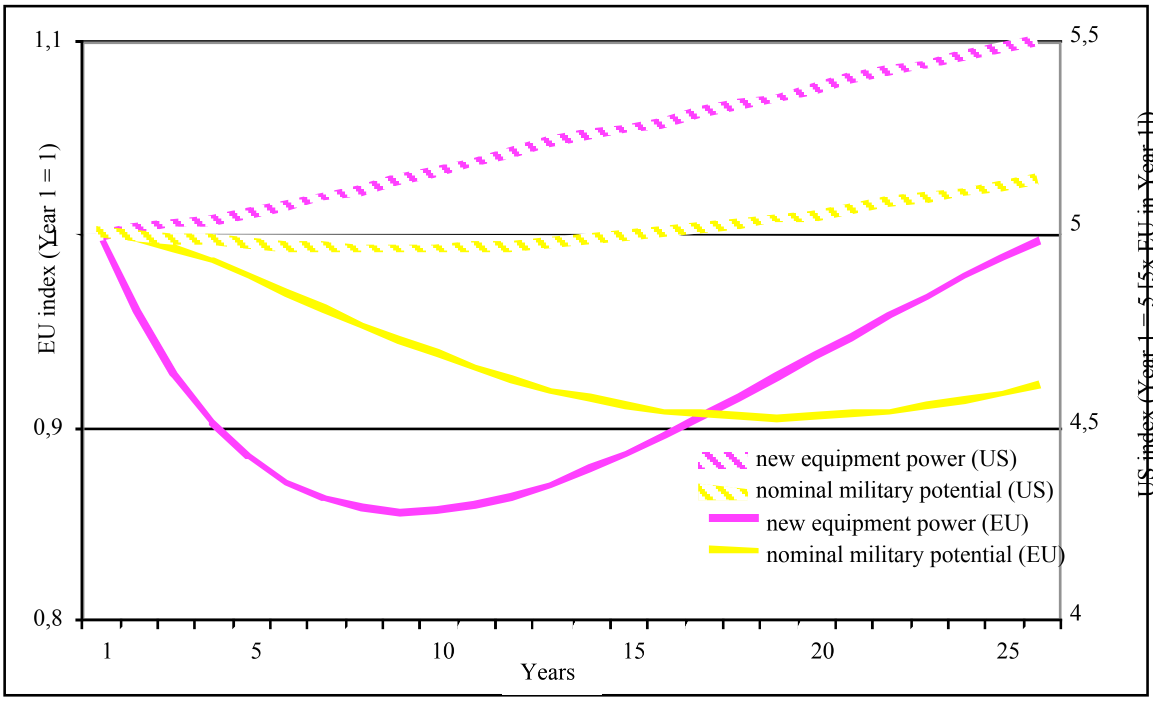
2. *Nominal military potential:* Averages TF over the **whole** life-time of hardware, and applies it to the total amount of military hardware inventory and adjusts for the military manning size.

In the following graphs, the 2003 EU levels are initiated at 1 and US to 5. A 25-year simulation is shown.

Base case

Graph 1 below shows the base case with 25 year stable defence budgets at current 330 $ billion level for the US and 198 $billion level for EU and no policy changes are made:

[11] SPRU (1996) shows that R&D impacts economic growth in highly uncertain and complicated ways. The above discussion however clearly indicates the importance of defence R&D for defence output.

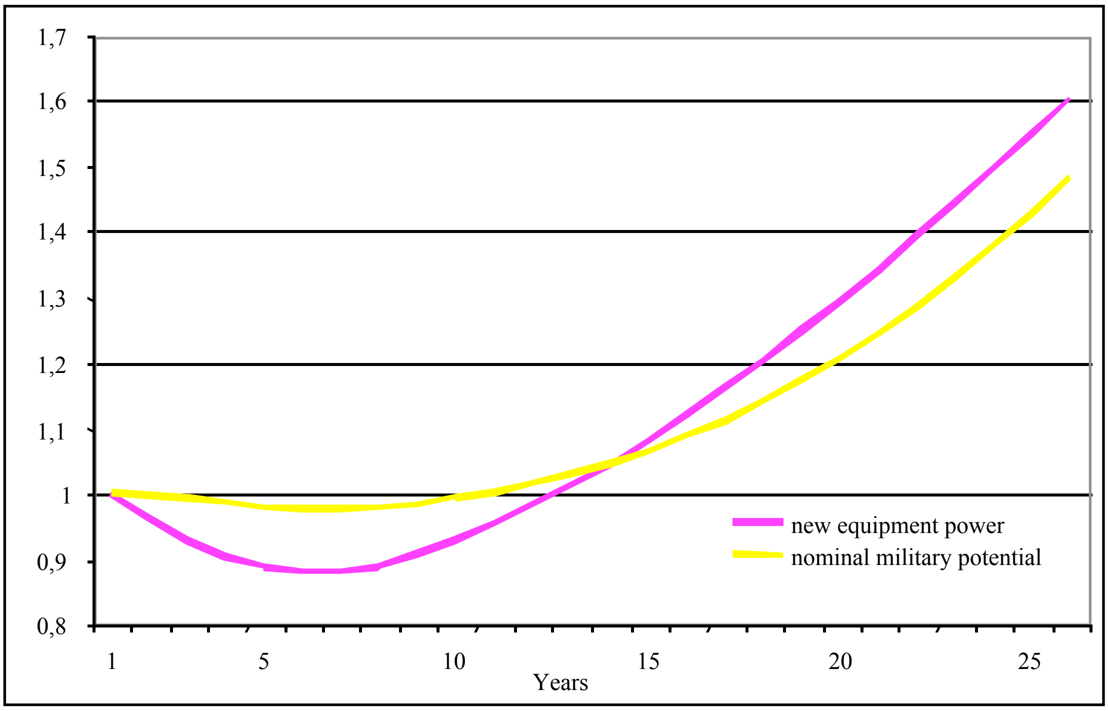


Graph 1: Base case.

In graph 1 ADTG continues to increase; the initial gap of factor 5(to 10) is increasing for the entire 25-year simulation period. Worse than that, the European performance indicators are both falling for the first 10-15 years, not to recover to initial levels before year 25. The loss of absolute EU power is mostly caused by low EU investment levels, too low to enable a replacement of aging equipment stock.

Industrial policy

It is often argued that the triumph of national politics in Europe is the main cause of the ADTG. In order to investigate this claim, a consolidation of industrial policy was implemented mostly by an initial and lasting boost to European industrial productivity. At the same time, a related policy coordinated European ambient R&D policy by rewarding quality much as is done by the US National Science Foundation. This would not have to cost anything in financial terms; Europe already spends more government funds on non-military R&D than does the US. On top of that, this industrial policy assumes that the ambient corporate R&D efforts initially jump to US levels. The cost of the entire policy will be born outside of government.

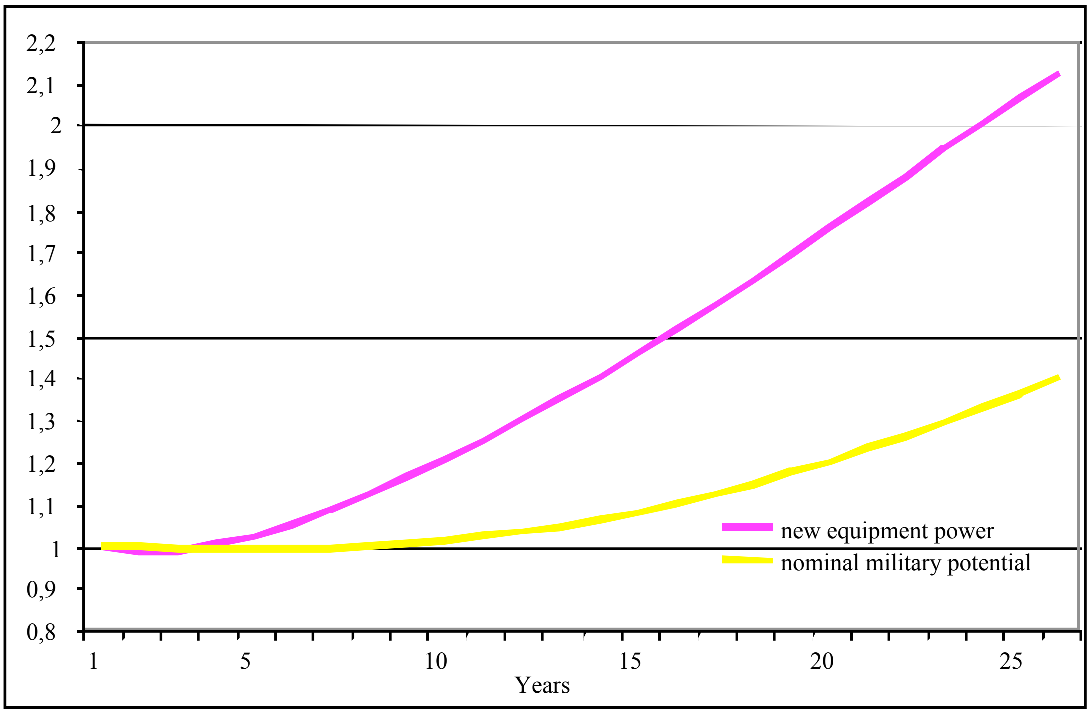


Graph 2: Implementation of a successful industrial policy.

Policy 2 indeed helps to close the technology gap, but very marginally. With all the positive assumed effects – and all for free, the EU power increases to 1,6 from 1, whereas the US base case showed its power increase to 5,5 from 5 within a 25-year time frame.

Budget policy

Assuming that European Defence budgets increase about 2 % per year, they will attain US levels in 25 years. The policy consequences are shown in graph 4.



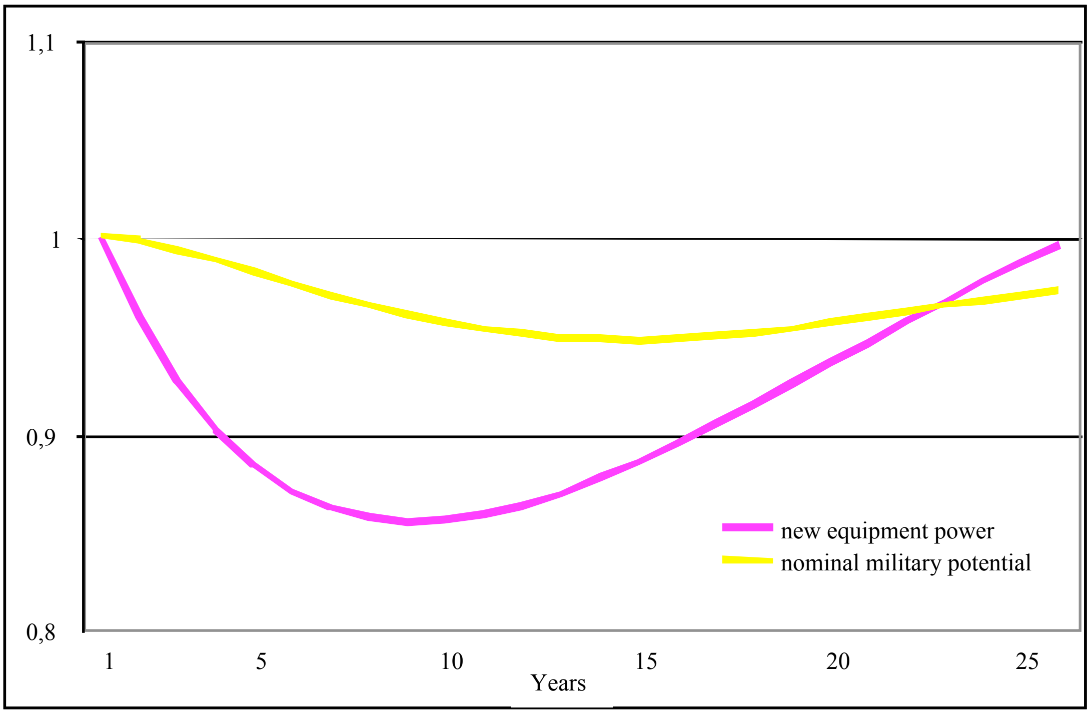
Graph 3: Consequences of achieving US defence budget levels in 25 years.

Compared to the previously investigated industrial policy, a defence budget policy delivers more. This can be explained by it being a faster policy. The industrial policy needs to await the slow (and uncertain) effects of industrial restructuring, and the even slower effects of new government and corporate strategies towards R&D.

However, an industrial policy is more powerful in the longer run, and the ”new equipment power” indexes for the two policies cross each other after about 5 more years, after which the industrial policy wins (not shown here).

Defence policy

This policy assumes instant conversion of all conscript forces to professional ones at no cost. The policy is implemented by assuming that professional forces are better trained and perform better, especially with more advanced equipment.

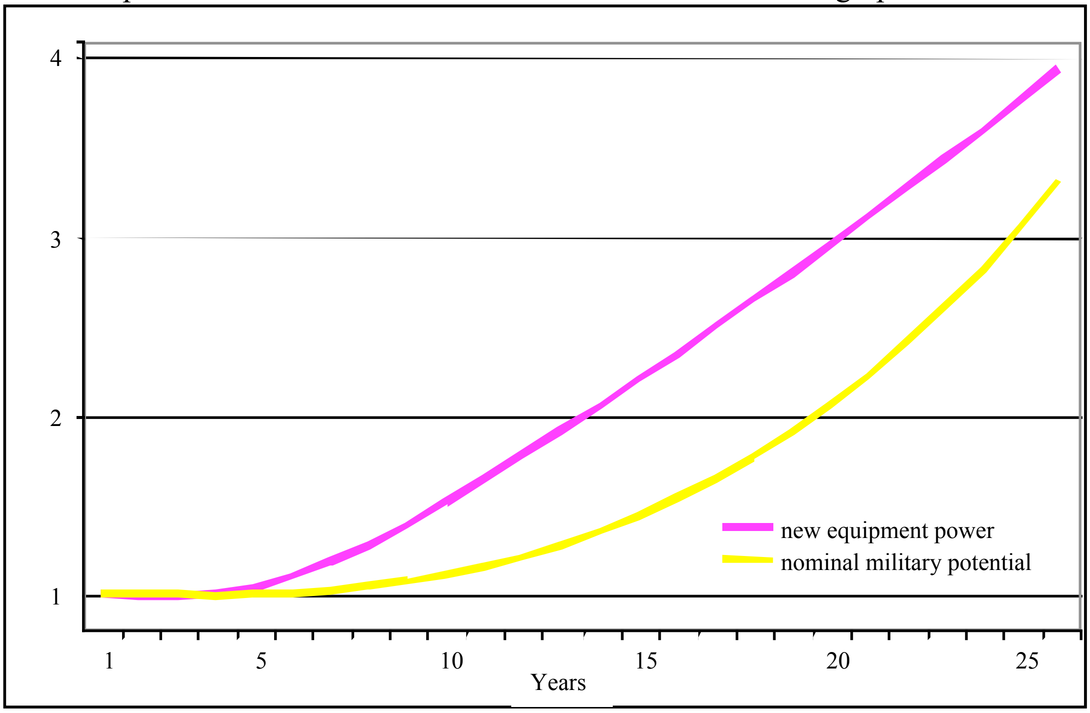


Graph 4: Defence policy; conscription forces are substituted by professional ones

A transformation of largely conscript forces into professional ones shows very limited results. It does however help the military potential to fall slower than in the base case.

A combined policy

All three policies were then combined. The results are shown in graph 6.



Graph 5: A concerted combination of an industrial, budget and defence policy.

Not surprisingly this policy outperforms all others. However, the simulation also shows synergy effects between the policies, they are multiplicative rather than additive. But even this combined policy only marginally closes the initial technology gap. It was noted that the gap today amounts to a factor 5-10 when it comes to advanced fielded hardware, whereas only a factor 4 is achieved with a coordinated set of policies.

Conclusion and discussion of implementation

The above analysis has shown that there is a technology gap over the Atlantic. In terms of fielded defence equipment, one may say that Europe is trailing the US by a factor of five to ten. A concerted effort over 25 years with a combined industrial, defence and budget policy in Europe may marginally close this gap if the US does not further improve upon its own policy.

There is however, little likelihood that such a combined policy will ever be implemented. Even if it did, it is unlikely that the US would allow this significant shift in transatlantic relations to happen. First, it is likely that further US restructuring and R&D intensity efforts will continue. Second, the US would watch a stronger EU with ambiguity. On the one hand, ever since president Kennedy argued for a "two pillar NATO" where US and Europe would be equal partners, US has espoused a stronger NATO Europe, but on the other hand conservative Americans see a realization of a strong EU as having problematic consequences for a US that would be dethroned as an unquestionable military world leader (Albright, 2003).

The reasons why a combined European policy would not be implemented are many: The only policy with marginal costs and high likelihood of implementation is the abolishment of conscription (BBC, 2004). Unfortunately, this policy has close to no effects. The budget policy is perhaps also achievable in these days of implied terror threats. But with retirement age population skyrocketing within the same 25 year time horizon as the simulation study has investigated, and most European health care likely to remain government paid, it is hard to see this budget policy being viable after five to ten initial years (barring major increases in perceived security risks close to home). The most effective in the long run, yet least likely policy, is the industrial one. Certainly, it is being partly on its way to implementation. However, the full implementation required as stated here, has been discussed for the last 15 years. It is meeting with ever increasing resistance from all walks of societies. For instance, during the winter of 2004, both German and French scientists have been striking and demonstrating to protest more "US-like" R&D policies from their respective governments (Lasterad and Nouhalat, 2004).

Finally, there exist a widespread ambiguity in Europe against using advanced weapons as a security instrument of choice (EU, 2003; BBC 2004). This was clearly seen in the European scepticism towards the US led invasion of Iraq. Consequently, many Europeans and their government believe that neither the world nor their own security would be significantly improved if the technology gap were to disappear.

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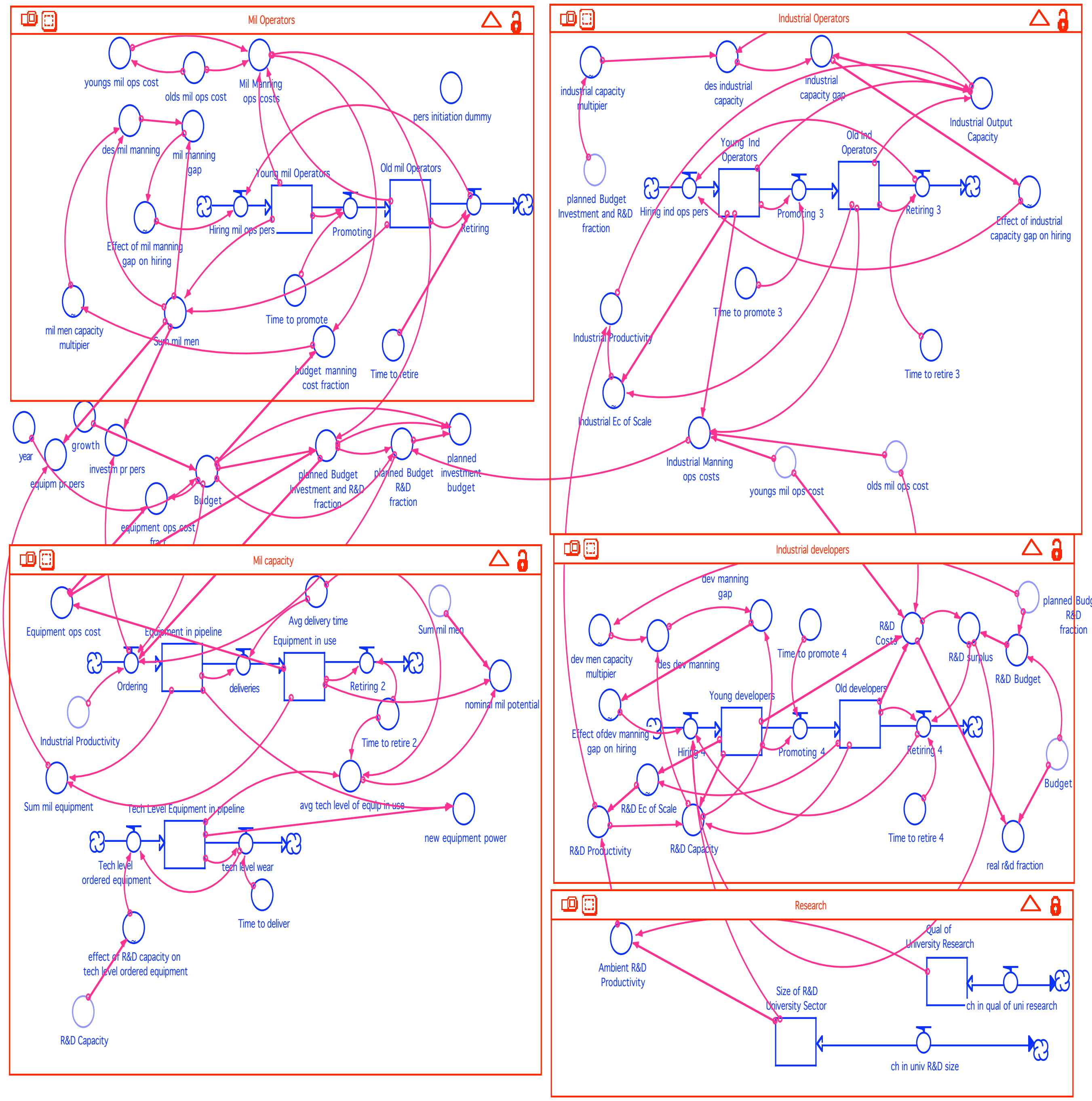
Appendix: ithink diagram



Back to the Top