Part V – The German Armed Forces (Wehrmacht), Mobilisation and War Economy from June to December 1941

Chapter V-1: Overview of the Structure and Terms Used in the German Fully Integrated Land and Air Resource Model (FILARM)

This chapter presents an overview of the German FILARM model, which is detailed in the subsequent chapters 2 to 10 of Part V of this work. The aim here is to provide the reader with an overview of the German model so that the reader can understand the basic elements of the model and how it aligns with the overall FILARM model structure defined in chapter I-3.[1] It is recommended the reader go through this chapter (I-3), which also defines the main terms and associated acronyms used in the FILARM model. The reader or researcher can also use this overview as a guide to the relevant chapter and section which contains the specific information they require. For example, information relating to German artillery weapons is found in section V 2. 4), while information relating to German corps artillery unit organisations is found in section V 3. 10) c.

The German 1941 Fully Integrated Land and Air Resource Model (German FILARM) uses the following chapters and major sections.

Chapter V- 2: The German Personnel and Equipment Resource Database

The German personnel and equipment resource database chapter contains an analysis of all the significant weapon systems and combat squads available to the German armed forces during 1941. It includes light and heavy infantry weapons, German squads equipped with light infantry weapons, artillery weapons, anti-aircraft weapons, tracked, half-tracked and wheeled AFVs (Armoured Fighting Vehicle), armoured trains, transport vehicles, prime movers, and all aircraft types.

As well as a brief history, the individual weapon system (including aircraft) and squad characteristics are analysed using the methodology detailed in Part II: The Barbarossa Simulation's Resource Database. The parameters calculated using this methodology includes: the individual Weapon Combat Power Coefficient (WCPC) values, and the individual weapon system and squad Overall Combat Power Coefficient (OCPC) values.[2]

Additionally, specific combat attributes are calculated for each weapon system and squad in the German personnel and equipment resource database. These combat attributes include: the Relative Overall Attack (ATT) value, the Relative Overall Defence (DEF) value, the Relative Anti-Personnel (APer) value, the Relative Anti-Armour (AT) value, the Relative Anti-Aircraft (AA) value, the Relative Armour Defence Strength value (ARM), the Relative Assault Defence Strength (ADS) value, the Relative Assault Attack Strength (AAS) value, the Relative Supply Demand Factor (SDF) value, and several others.[3] These combat attributes would be used to simulate the basic combat power of German weapon systems and squads in any computer based simulation of Operation Barbarossa, such as that discussed in Part VII.[4]

[1] Part I 3. – 'Military Simulations, and the General Structure of the Integrated Land and Air Resource Model - The Structure of the Fully Integrated Land and Air Resource Model (FILARM)'.
[2] Part II 2. – 'The Barbarossa Simulation's Resource Database - Methodology for Calculating a Weapon System's or Database Unit's Overall Combat Power Coefficient (OCPC)'.
[3] Part II 3. – 'Methodology for Calculating a Weapon System's or Database Unit's Specific Combat Attributes'.
[4] Part VII - 'Complete Simulation of Operation Barbarossa: 22nd June to 31st December 1941'.

***

Chapter V- 3: The Tables of Organisation and Equipment (TOE) for German Land Combat Units from 22nd June to 31st December 1941; and The Unit's Actual Organisation and Equipment in 1941

All combat capable organisations in the German armed forces are defined as combat units, and all these combat units had a Table of Organisation and Equipment (TOE) regardless of their size. The German equivalent term was *Kriegstarkenachweisungen* (KStN) while the Soviet term was *Shtaty*. Chapter V-3 (by far the largest chapter in the German FILARM model) contains analyses of the TOEs of German land combat units Deployed (D) on 22nd June 1941, and land combat units which were newly mobilised from 22nd June to 31st December 1941. Deployed (D) units existed and were available between 22nd June and 4th July 1941 (see chapter V-4, below, the 'German Deployment Matrix'), while newly mobilised units include Mobilised and Deployed (MD) units, and Mobilised and Not Deployed (MND) units. The TOEs for individual combat unit types (eg, infantry divisions or panzer divisions, etc) are shown in terms of the German Personnel and Equipment Resource Database (chapter IV-2, above).

As with most armies, in the German Army the TOE of a combat unit was often not its actual strength. However, due to the build-up of forces and preparations for Operation Barbarossa, in late June 1941 the German Army's combat units were closer to their TOE strengths than at any other time during WWII. After this time, steady casualties and attrition on multiple fronts ensured that the large majority of the German Army's combat units never again came as close to their full TOE strengths.[5] Nevertheless, on 22nd June 1941 a great many units were still not at their authorised strength or/and were not organised exactly as per the unit type's TOE. There were main two reasons for this:

- Firstly, shortages of equipment meant that many divisions either did without altogether or substituted other equipment in its place. For example, in German 2nd Wave Infantry Divisions the regimental anti-tank companies were authorised 9 37mm Pak 36 and 2 50mm Pak 38 anti-tank guns. However, due to shortages of the Pak 38 gun, most of the regimental anti-tank companies in these divisions had 12 Pak 36s instead. This also meant that the latter regiments had different numbers and types of towing vehicles and other support elements. There are a great many examples like this, in almost all division types, as well as in smaller 'corps' and 'army' support units.
- Secondly, many German divisions simply deviated slightly in their individual TOE organisation from the 'standard' structure. The reasons for this are unclear but were possibly due to the evolutionary nature of the German Army or/and the fact that divisions were mobilised in diverse military districts. In addition, KStN could be modified by General Army Memorandums (*Allgemeine Heeresmitteilungen* – AHM) and also by orders issued by the various arms inspectorates or higher headquarters. These departments continually changed and modified KStNs, sometimes by as little as one vehicle. On 22nd June 1941 some units were actually over strength, usually due to some unique organisational feature, although this was relatively rare.

In addition to the above, the German Army, and Wehrmacht in general, had a large number of completely unique units. Examples in June 1941 included the 7th Flieger Division, the 900th Motorised Lehr Brigade, the Gross-Deutschland Motorised Infantry Regiment, and the

[5] By 1943-44 this had become so chronic that the Germans were forced to radically reduce the size of their divisional TOEs. For example, the 1st Wave 1941 Infantry Division had three infantry regiments each with three battalions, while the Type 44 German Infantry Division had three infantry regiments each with two (reduced size) battalions.

Leibstandarte SS Adolf Hitler (LSSAH) Motorised Brigade.[6] All these units had both unique organisations and actual strengths on 22nd June 1941.

For the above reasons, in chapter V-3 we examine each German division type's TOE separately, and where appropriate detail the individual divisions of that type which deviated from this 'standard' TOE structure in any known way. In addition, where known, the actual personnel and equipment in an individual division is shown. For Deployed (D) units the organisation and strength between 22nd June and 4th July 1941 is used, and for MD units the known strength when the unit arrived on the East Front is used. Note, MND (Mobilised and Not Deployed) units were not deployed to an active front in 1941 so the strength used is that achieved by late December 1941.

Additionally, for the most important combat unit types such as infantry divisions, panzer divisions and Waffen SS motorised divisions, various analyses (some extensive) are included as to why certain German TOE structures were so effective compared to many contemporary armies in 1941. Comparisons are made with particular reference to the Red Army's divisional structures in 1941. Also, for the most important divisions a summary of the unit's history is included from the time it was formed to the end of 1941. This includes information on its formation, any major structural modifications and its battle record.

***

The German land combat units are categorised and analysed under the following section numbers and major headings (refer Part V Table of Contents for full section and subsection details):

2. German Army Infantry Units (includes, infantry division waves (*Welle*), the German division's organisation and equipment: enhanced combat efficiency, the 1st to17th wave infantry divisions, the 250th Infantry Division (Spanish), separate infantry regiments and separate infantry battalions).
3. German Army Armoured and Mechanised Units (includes 1940 vs. 1941 panzer division, German panzer division TOE vs. Soviet tank division TOE, equipment shortages and variations in Panzer Divisions, the 1st to 24th Panzer Divisions, the 5th Light Division, separate panzer brigades, separate panzer regiments, separate panzer battalions and panzer companies, flame-panzer battalions, assault gun battalions and self-propelled panzerjager battalions (armoured)).
4. German Army Motorised Units (includes motorised divisions, separate motorised infantry brigades, separate motorised infantry regiments and separate motorised infantry battalions).
5. German Army Cavalry Units (includes the 1st Cavalry Division).
6. German Army Mountain Units (includes mountain divisions and separate mountain units)
7. Luftwaffe Airborne Units (includes the 7th Fleiger Division and separate airborne units).
8. German Army Security and Militia Units (includes security divisions, separate security brigades, separate security regiments, *Landesschutzen* (LS) battalions and military police battalions).
9. Waffen SS Combat Units (includes Waffen SS motorised divisions, Waffen SS motorised brigades, Waffen SS cavalry units, SS police units, and separate Waffen SS *Freiwilligen* infantry regiments and battalions).
10. German Army Corps, Army and Army Group Level Units (includes higher headquarter units, higher headquarters signal units, artillery units (all types), rocket artillery (*Nebelwerfer*) units, anti-tank units, army anti-aircraft (Flak) units, machine gun battalions, combat engineer

[6] The Waffen SS had their own KStN, many of which were different from the 'equivalent' Army KStN. The LSSAH was still a brigade in June 1941 and was also organised very differently to the Waffen SS Motorised Divisions.

(*Pionier)* and special engineer units, army construction units, armoured trains, and railroad engineer (*Eisenbahn Pionier*) and construction units).

11. Luftwaffe Anti-Aircraft (Flak) Units (includes Luftwaffe flak HQs, Luftwaffe mixed flak battalions and Luftwaffe light flak battalions).

The last section in chapter V-3 (section 12) is an examination of the authorised sizes of German divisions and brigades fielded from 22nd June to 31st December 1941. This includes calculations for the relative size of the German divisions and brigades fielded in 1941, using the methodology defined in chapter I-10, and an application of the Minimum Divisional Size (MDS) value.[7] From this analysis we gain an appreciation of which German land combat units could reasonably be called 'divisional sized' units, and a better understanding of the relative size and power of the German ground forces fielded during 1941.

***

Chapter V- 4: The Order of Battle (OOB) of German Land Combat Units from 22nd June to 4th July 1941

On 22nd June 1941 the Wehrmacht (including Waffen SS) had 208 divisions; made up of 153 infantry divisions, 20 panzer divisions, 11 motorised divisions (including the 5th Light in North Africa), 3 Waffen SS motorised divisions, 1 cavalry division, 6 mountain divisions, 4 light infantry divisions, 1 airborne division and 9 small security divisions. Of this number, 138 divisions were deployed in the east between 22nd June and 4th July 1941 in support of Operation Barbarossa. This includes combat units in OKH Reserve, which were in transit and arrived on the East Front by 4th July 1941. This force (on the East Front) comprised 91 infantry divisions, 17 panzer divisions, 9 motorised divisions, 3 Waffen SS motorised divisions, 1 cavalry division, 4 mountain divisions, 4 light infantry divisions and 9 security divisions. In addition to the divisions, there existed an enormous number of smaller combat units ranging in size from large 'division sized' brigades to small Flak companies. On 22nd June 1941 the large majority of these units were also deployed on the East Front attached to the various army and corps level HQs.

Chapter V-4 includes a full Order of Battle (OOB) for of all German Army, Waffen SS, Luftwaffe Flak and coastal artillery units, in all military districts and army commands in the Reich, from 22nd June to 4th July 1941. The German OOB is detailed in a series of large table matrices; effectively one for each Army, Panzer Group, Army Group Reserve, OKH Reserve, separate Corps Command (i.e. the Deutsches Afrika Korps) and Replacement Army, which together is termed the 'German Deployment Matrix'. In the German FILARM model <u>all</u> combat units in the German Deployment Matrix are henceforth classified as having been in a Deployed (D) state.[8] Note, all combat units in the German Deployment Matrix had a specific TOE, which is detailed in chapter V 3 (above).

***

Chapter V- 5: German Land Combat Unit Reinforcements on the East Front from 5th July to 31st December 1941

This chapter details the transfer schedule of German land combat units to the East Front from 5th July to 31st December 1941, by German Army, Waffen SS and Luftwaffe Flak units. It includes

[7] Part I 10. – 'Military Simulations, and the General Structure of the Integrated Land and Air Resource Model - A Divisional Sized or Division Equivalent Combat Unit in WWII' details the equations used for calculating a land combat unit's 'size', and defines the Minimum Divisional Size (MDS) value. The latter is essentially the minimum sized combat unit that can be reasonably called 'divisional sized' or a 'division equivalent' in 1941.

[8] Part I 3. 3) a. i. – 'The Structure of the Fully Integrated Land and Air Resource Model (FILARM) - Resource Allocation States inside the FILARM Model - Combat Units: D, MD and MND - Deployed (D)'.

Deployed (D) land combat units transferred to the East Front from the Western Fronts or the Replacement Army, and land combat units which were mobilised after 4th July 1941 and then deployed to the East Front before the end of the year (i.e. Mobilised and Deployed (MD) combat units). The 'East Front' includes forces assigned to Army Group North, Army Group Centre, Army Group South, the Norway Army - *Befehlsstelle Finnland* (East Front only) and OKH Reserves. Also included is relevant information on the individual combat unit's initial assignment on the East Front (if known).

***

Chapter V- 6: The Total Personnel and Equipment in a Deployed (D) State in the Reich from 22nd June to 4th July 1941

Chapter V-6 of the German FILARM model is concerned with how many of the available personnel (in the Reich) were allocated to ground combat units, how much of the available equipment was allocated to ground combat units, the availability of motorised transport for supply functions, and, in general, the extent to which the Wehrmacht and German war-economy were stretched in order to mount Operation Barbarossa in June 1941.

Section V- 6-1: The Total Personnel and Equipment Allocated to Combat Units and in a Deployed (D) state in the German Army, Waffen SS, Luftwaffe Ground Forces and Naval Coastal Artillery from 22nd June to 4th July 1941

Drawing on the relevant data in chapters V-4 and V-5 (above), this section ascertains the total personnel and equipment allocated to ground combat units, and hence in a Deployed (D) state, in the Reich from 22nd June to 4th July 1941. The information is presented in two large matrices which show the personnel and equipment in each Army, Panzer Group, Army Group Reserve, Army Group, OKH Reserve, separate Corps Command and Replacement Army.

The first matrix is devoted to the personnel and equipment on the East Front from 22nd June to 4th July 1941. It includes all the ground forces in Army Group North, Army Group Centre, Army Group South, the Norway Army (*Befehlsstelle Finnland* - East Front only) and OKH Reserves. The second matrix is devoted to the personnel and equipment in the Western Fronts and the Replacement Army from 22nd June to 4th July 1941. It includes all the ground forces in the Norway Army (Norway occupation duties), Army Group D (France-Low Countries), the 12th Army (Yugoslavia-Serbia-Greece-Crete), the Deutsches Afrika Corps (D.A.K - North Africa), the Replacement Army, and Germany and the remainder of occupied Europe.

A very important 'side subject' is highlighted here: specifically the amount of rear-area transport that was available to the Wehrmacht in June 1941. This had a very strong influence on the German Army's overall Supply Distribution Efficiency (SDE) and mobility during the 1941 campaign, which is covered in detail in chapter V-9 (below).[9]

Section V- 6- 2: The Total Available Personnel and Equipment in the Reich on 1st June 1941

This section details the total personnel and equipment inventory that was available to the Wehrmacht (including the Waffen SS) on 1st June 1941. This date is selected because most of the historical inventory returns are dated for the first of the month, and information related to war production is most commonly stated as output by month. The subsequent subsections contain reviews (and analyses) of the available small arms and other infantry weapons, anti-tank weapons, artillery pieces, anti-aircraft weapons, tanks and other AFVs, motor vehicles and other transport types, and Wehrmacht personnel.

[9] Part V 9. – 'The Supply Distribution Efficiency (SDE) for the Wehrmacht on the East Front from 22nd June to 31st December 1941'.

Section V- 6- 3: The Proportion of Total Available Resources which were in a Deployed (D) State in the Reich from 22nd June to 4th July 1941

The last section in chapter V-6 establishes the proportion of total personnel and equipment (resources) that was available across the Reich, and which were already utilised in Deployed (D) combat units from 22nd June to 4th July 1941. It draws primarily on information presented in the previous two sections and involves some manipulation of the data: mainly grouping the total equipment allocated to combat units into appropriate equipment or weapon subtypes. This section includes an analysis of the above data, and some important conclusions regarding shortages (or not) of transport, weapons and equipment in the German Army, Waffen SS and Luftwaffe Ground Forces on 22nd June 1941. This analysis reveals some expected results, as well as some more surprising (and thus perhaps more illuminating) results.

***

Chapter V- 7: German Mobilisation After 22nd June 1941: the Actual Strength of German Land Combat Units Mobilised from 22nd June to 31st December 1941

While the Soviets embarked on what became the largest and fastest war mobilisation effort ever carried out by a single country, the Germans appeared confident (and in the end over-confident) that their existing forces in the East would crush the USSR by year's end. Consequently, the German forces Mobilised and Deployed (MD) on the East Front from June to December 1941 bordered on non-existent compared to the Red Army's MD forces. In this chapter we focus on the Wehrmacht and Waffen SS forces that were mobilised during the second half of 1941, the resources available in the Reich to meet this demand, and the Replacements (R) available for combat units already deployed on the East Front during 1941.

The first two sections in this chapter focus on the methodology employed to analyse the German mobilisation (including defining D, MD and MND units), and the individual land combat units mobilised during the second half of 1941. This includes information on when and where the unit started its formation, its status by the end of 1941, and whether or not it was Deployed (D) to an active front line HQ during 1941.

Details on the newly mobilised German armoured, mechanised and motorised units, also enables us to build a 'German Tank MD and MND Matrix'. The German Tank MD and MND Matrix presents a detailed picture of the tanks, assault guns and armoured self-propelled guns (together called AFVs) allocated to newly mobilised combat units from 22nd June to 31st December 1941. The matrix also tracks the following: AFVs allocated to panzer units Deployed (D) on 22nd June 1941 but not yet fully formed, AFVs allocated to refurbish/reorganise Deployed (D) panzer units during 1941, AFVs existing on 22nd June 1941 that were not allocated to any unit (hence were not Deployed (D) themselves) and which became serviceable and available before 31st December 1941, AFVs that became available due to the disbandment or reorganisation of units which were Deployed (D) on 22nd June 1941, and new AFVs manufactured from 22nd June to 31st December 1941. The last segment includes some surprising conclusions in regards to the AFV replacements actually sent to the East Front and the number of AFVs that were available but remained in the West during 1941.

Section V- 7- 3: The Total Resources Allocated to Newly Mobilised Combat Units from 22nd June to 31st December 1941

Using the information above, and the relevant sections from chapter V-3, the total resources allocated to MD and MND units from 22nd June to 31st December 1941 is established. In addition we are now also able to ascertain the additional 'rear area transport' available for supply distribution in the German armed forces from 22nd June to 31st December 1941.

Section V- 7- 4: The Total Resources in the Reich that were Available for Use by Newly Mobilised Units from 22nd June to 31st December 1941

In this section we examine the total resources available in the Reich to newly mobilising German combat units during the second half of 1941. The resources available included: existing equipment resources that were not utilised by Deployed (D) units from 22nd June to 4th July 1941, all personnel mobilised (called up) after 22nd June 1941, commandeered equipment from the civilian economy (especially motorised transport), and weapons and transport manufactured from 22nd June to 31st December 1941.

For the latter, monthly production figures and inventories are used (where available) under the following subsections: small arms and other infantry weapons, anti-tank weapons, artillery pieces, anti-aircraft weapons, tanks and other AFVs, motor vehicles and other transport types, and newly conscripted Wehrmacht personnel.

Section V- 7- 5: Resources Unallocated to any Deployed (D), MD or MND Units in 1941

Having determined the total resources used in all German D, MD and MND combat units in 1941, and having determined the total resources in the Reich that were available in 1941 (above), we can now easily calculate the resources 'left over': in this section we consider the personnel and equipment initially unallocated to any Deployed (D), MD or MND units during 1941. Particular attention is paid to the number of personnel that went into 'rear area' support functions supporting the Army (*Heer*), Luftwaffe, Kriegsmarine and Waffen SS. In addition, German AFVs that became available due to the disbanding and reorganisation of Deployed (D) panzer units, and from refurbished captured stock, has to be taken into account. Note, these AFVs are also detailed in the 'German Tank MD and MND Matrix'.

Section V- 7- 6: The Proportion of Total Available Resources Allocated to Deployed (D) and Newly Mobilised Units in 1941

In section V-7-6 we draw on the data in the preceding sections (as well as chapter V-6-3) to draw conclusions in regards to the overall personnel and equipment shortages (or otherwise) in the German forces during 1941. A detailed comparison is made with the equivalent figures from the Soviet FILARM model to ascertain if the German mobilisation during 1941 suffered from the same weaknesses, bottlenecks and constraints as the immense Soviet mobilisation did during this period. The somewhat surprising conclusions from this analysis is that the primary limiting factors on the German's mobilisation effort were political and the result of strategic policy, and were <u>not</u> primarily the number of available personnel and amount of equipment.

Section V- 7- 7: The Resource Replacements (R) Available to the German Army, Waffen SS, Luftwaffe Ground Forces and Naval Coastal Artillery, from 22nd June to 31st December 1941

In the final section on German ground forces mobilised during 1941, the personnel and equipment utilised by the Germans as Replacements (R) for combat and attrition losses is considered.[10] The first step in this process is a detailed examination of the structure and function of the German Replacement Army and *Wehrkreise* (military district) system in Germany, and some of the annexed territories, during WWII. This little known system was probably one of the few German military-economic organisations (in WWII history) that proved more efficient and effective than its Western Allied counterparts.

The second step is an analysis of the Replacements (R) available to the Wehrmacht from June to December 1941, and then the <u>actual</u> Replacements (R) sent to the German ground forces on the

[10] Part I 3. 3) c. – 'The Structure of the Fully Integrated Land and Air Resource Model (FILARM) - Resource Allocation States inside the FILARM Model - Reserves and Replacements (R)'.

East Front during the second half of 1941. The German Replacements (R) are considered in terms of the German Personnel and Equipment Resource Database (chapter V- 2), so they can be used in any computer based simulation of Operation Barbarossa. The discussion on German Replacements (R) during 1941 encompasses the following:

- German personnel losses and replacements. This includes a look at the German OKW's ready replacements earmarked for Operation Barbarossa, the number of 'ready' replacements in The Replacement Army, a comparison of the monthly German personnel casualties on the East front during 1941 against the replacements actually used (and vs the number available), and some conclusions in regards to the German strategic policy decisions to restrict their personnel Replacements (R) during 1941.
- German tank and assault gun losses and replacements. This includes a detailed examination of the panzer divisions' tank status around the middle of the 1941 campaign, German tank and assault gun losses and (tanks rebuilt) on all fronts from June to December 1941, new tanks produced (manufactured) from June to December 1941, tanks ready for issue by month (from new production) from June to December 1941, German tank Replacements (R) actually sent to the East Front from June 1941 to December 1941/January 1942, German tank Replacements (R) sent to the DAK (North Africa) from June 1941 to December 1941/January 1942, and conclusions in regards to the German strategic policy decisions to restrict their tank (and assault gun) Replacements (R) during 1941.
- Small arms used in the Reich during 1941, including by all ground combat units and Replacements (R).
- The personnel used by all types of Replacements (R). Here personnel used as 'crews' accompanying new weapon and transport type Replacements (R) are considered.

***

Chapter V- 8: The Luftwaffe in 1941

All the previous chapters in Part V (the German FILARM model) focused on land combat units. In chapter V-8 we focus on the Luftwaffe (German Air Force) during 1941.

Section V- 8- 1: The Structure of the Luftwaffe: June to December 1941

The first step in scrutinising the Luftwaffe during 1941 involves an examination of its command structure and air-unit TOE organisations. This encompasses the higher level strategic and operational level organisations such as the *Luftflotte, Fliegerkorps, Geschwader* and *Gruppe*; and down to the tactical level organisations such as the *Staffel, Schwarm* and *Rotte*. All types of air unit are considered; including fighter, heavy-fighter, night-fighter, ground-attack, dive-bomber, high-speed bomber, bomber, marine, transport and reconnaissance units. Similarly to the German land combat units, the TOEs for air combat units rarely corresponded to their actual strength: this is ascertained for individual air combat units in the next section.

Section V- 8- 2: The Order of Battle and Actual Strength of all Luftwaffe Air Combat Units in a Deployed (D) State on 21st June 1941

In section V-8-2 we consider the Order of Battle (OOB) and actual strength of all German air combat units, in all areas of the Reich, on 21st June 1941. Initially, the Luftwaffe higher-level organisation and chain of command on the eve of Operation Barbarossa is examined. This includes a look at the *Luftgaukommandos* (Air district commands) responsible for the Luftwaffe's ground forces supporting the air operations (including the Luftwaffe Flak Corps' supporting Operation Barbarossa).

The subsequent subsections are then devoted to a detailed examination of the air-units within each of the Luftwaffe's main operational commands. These were as follows: Luftflotte 1, Luftflotte 2, Luftflotte 4 and part of Luftflotte 5 on the East Front; and most of Luftflotte 5, Luftflotte 3, X. Fliegerkorps, Luftwaffenbefehlshaber Mitte and Luftflotte ObdL on the Western Fronts and in Germany. The actual strength of German air combat units includes the serviceability and numbers of operational aircraft. In addition, comparisons are made to relevant opposing VVS or RAF forces in June-July 1941, along with a brief history of air-operations within each of the operational commands (above).

Section V- 8- 3: Luftwaffe Strengths on 21st June 1941

From the preceding sections (and a little additional information) it is now possible to obtain a complete picture of the Luftwaffe strength available to support Operation Barbarossa in June and early July 1941. This data is compiled and presented in this section. The Luftwaffe aircraft strengths on the East Front are then compared, quantitatively and qualitatively, with the opposing VVS forces in the Soviet Western Military Districts on 22nd June 1941.

There follows an objective analysis of the actual Luftwaffe forces available to support German ground operations during Operation Barbarossa, which reveals some startling results. Most obvious is the fact that the Luftwaffe forces fielded in support of Operation Barbarossa were relatively small by WWII standards, and were in fact 'minimal' when one considers the magnitude of the task facing them. The final subsection presents a compilation of data to show the overall Luftwaffe strengths on 21st June 1941, and the proportion of each type of aircraft assigned to the East Front and western fronts at this time.

Section V- 8- 4: Luftwaffe Air Combat Unit Reinforcements: June to December 1941

In this section we examine the movements of Luftwaffe air combat units deployed on 21st June 1941 (i.e. Deployed (D)), as well as newly mobilised units, from June to December 1941. This discussion encompasses three general areas:

- The transfer of Deployed (D) and newly mobilised air combat units to the East Front from 22nd June to 31st December 1941.
- The transfer (withdrawal) of air combat units from the East Front to the west from 22nd June to 31st December 1941. This includes the withdrawal of Luftflotte 2 and II. Fliegerkorps, and their associated air units.
- Air combat units that were newly mobilised from 22nd June to 31st December 1941. Newly mobilised units include units formed after 22nd June 1941 from existing training units or as completely new formations.

Section V- 8- 5: Overall Luftwaffe Combat Aircraft Usage, Production and Replacements (R): 22nd June to 31st December 1941

In the final section relating to the Luftwaffe in 1941, we examine the overall usage and production of combat aircraft in the Reich from 22nd June to 31st December 1941. Note, combat aircraft in this instance includes transport and courier-liaison (army cooperation) aircraft, but excludes training aircraft. This analysis includes the following:

- Combat aircraft used by newly mobilised air combat units, on the East Front and western fronts, from 22nd June to 31st December 1941.
- Combat aircraft production (by type) from June to 31st December 1941.
- Combat aircraft Replacements (R) sent to the East Front and western fronts from 22nd June to 26th December 1941.

- Combat aircraft used in 'rear area' organisations from 22nd June to 31st December 1941.

A final review (analysis) is carried out on the Luftwaffe losses, on all fronts, from June to December 1941, and how this correlated to the Luftwaffe's front line strength during this period. Luftwaffe losses examined include ground and air-crew personnel losses, as well as aircraft operational and combat losses. For context, these losses are also compared to the relevant VVS and RAF losses during this period.

***

Chapter V- 9: The Supply Distribution Efficiency (SDE) for the Wehrmacht on the East Front from 22nd June to 31st December 1941

In chapter V-9 the methodology relating to SDE detailed in Part I is applied to the German ground forces from June to December 1941.[11] A force's SDE has a direct impact on its Relative Overall Combat Proficiency (ROCP).[12]

The German SDE is considered for each of the following: the SDE for all Deployed (D) land combat units on the East Front from 22nd June to 4th July 1941, the SDE for all Reinforcement (R) land combat units on the East Front from 5th July to 31st December 1941, and the average SDE for all Deployed (D) and Reinforcement (R) land combat units on the East Front from 22nd June to 31st December 1941. In addition, (in a separate section) the supply and support infrastructure required to support Luftwaffe operations in 1941 is included in the overall analysis of the German armed force's SDE during 1941.

In calculating the SDE for the German armed forces on the East Front from 22nd June to 31st December 1941 certain specific parameters are used. These relate to the unique conditions or circumstances faced by the Wehrmacht on the East Front during 1941. These factors include: specific weapon system or squad Supply Demand Factors (SDFs), the proportion of available rear area trucks, tractors and light transports allocated to rear area support functions, the average lift capacity of the Wehrmacht's motorised vehicles and horse teams (measured in metric ton kilometres per day).

Finally, the Wehrmacht's SDE is compared to that of the Soviet armed forces during 1941, and some relevant conclusions are drawn.

***

Chapter V- 10: German Naval Forces on the East Front: June to December 1941

The last chapter of Part V (the German FILARM model) is devoted to the *Kriegsmarine* (German Navy) forces on the East Front during 1941. The initial section in this chapter is concerned with the German Navy's high level command structure in June 1941. The subsequent sections are devoted to the objectives of the German naval forces in the Baltic in 1941, an analysis of the actual strength of German naval units in the Baltic during 1941 (down to individual named ship and submarine level), and a history of German (and Finnish) naval operations in the Baltic from June to December 1941.

***

[11] Part I 9. – 'Military Simulations, and the General Structure of the Integrated Land and Air Resource Model - Supply Distribution Efficiency (SDE)'.
[12] Part III – 'Relative Overall Combat Proficiency (ROCP): the ROCP of Soviet and Axis Forces in 1941'.