Historical Analysis for the Realistic Representation of Time in Combat Simulations

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Abstract

The main subject of this paper examines historical evidence to determine if it is possible to provide quantified guidelines to war-gaming analysts and model developers on the representation of realistic battle times within war-games and models of land combat. Data from a number of historical case studies (WWII-Gulf War) were extracted and used to understand the realistic pace of events in an operation, including studying time between orders to advance, the rates of advance, obstacles and other problems.

The understanding of factors limiting operational tempo and the problems that may be encountered during an operation (and how to avoid them) are some of the key drivers to understanding the factors that lead to campaign success.

1. Introduction

Military Operational Analysis (OA) in the UK has been conducted since World War II (WWII), it is one of the key study methods used in Dstl[1] and is dependent on different techniques and data to analyse conflicts and operations, to aid planning and policy formulation within the Ministry of Defence (MOD). Techniques which have been used in OA to analyse conflict have included wargaming, computer modelling of campaigns and Historical Analysis (HA).

Wargaming is a conflict simulation that requires player interaction between either two teams (at least one player per side) and a game controller or one team against the game controller(s). The commander of each team will issue instructions to their forces, based on a given scenario (and certain rules as defined at the outset of the game, usually based on military advice and known analysis). The game controllers return information to the teams as determined by the rules. The cycle is repeated until one team achieves their objective or both teams mutually agree to finish the game. A wargame captures the decision-making processes of military officers and is flexible and fast to set up. Wargames however can be slow to run and the human element means they are never precisely repeatable.

Computer models (or combat simulations) have now largely replaced the wargame within Dstl and the OA community. A computer (closed) simulation of combat is similar to a wargame with two, simulated, sides trying to achieve an objective based on a set of guidelines and rules. These simulations tend to be quicker, repeatable, can be run both deterministically and (in some cases) stochastically, and produce far larger sets of results than a wargame could, aiding statistical analysis. Pure computer simulations, however, do not (once the simulation has been set running) contain the human interaction that wargames do, and hence there is still a place for wargaming within the OA community.

One of the major issues with wargames and combat simulations is they tend to be event (task) driven and do not take into account effects of friction and pacing of operations between events. This HA study of 'Timelines' in land combat was an exploratory study of the realistic pace and the drivers of events in divisional combat, in order to provide a sound basis for modelling and wargaming. Historical Analysis (HA) can be defined as the analysis of historical operations in order to provide a quantification of the driving factors inherent in military operations and conflict.

[1] Defence Science and Technology Laboratory, part of the MOD.

1.1 Aim

This paper is intended to present the quantitative and qualitative results of this study to inform combat modelling and wargaming analysts with a view to improving the representation of the effects of 'friction' on the pace and sequencing of engagements. The findings from this exploratory study offer some empirical relationships as a 'sanity check' to calibrate the pace of combat operations in models and indicate those areas where further analysis could be used to improve fidelity.

1.2 Scope of Data Sample

A sample of historical operations (see Appendix A)[2] from WWII (1940-44) and Op Desert Sabre (1991) was studied to try to determine the course of each battle, the key times and events (including orders at different levels) and the driving factors (including those due to problems) of these timings. Analysis of these was to complement previous HA (Watson & Rowland, 1987, and Rowland, Keys & Stephens, 1994) of rates of advance and of success at the operational level[3]. Where possible, complementary data from both sides of the operation was collected and studied.

Although offensive, defensive and meeting engagements were in the overall study plan the time and available data has meant that only offensive operations have provided useful samples for analysis. A total of 10-14 offensives[4] in contact have been studied in comparison with the orders given and the timings of those orders.

Historical data was collected for brigade (Bde) level upwards, up to an agreed maximum level for each operation. Data was sought for all activities identified in a recent study of urban operations (Passinhgam, 2002) including time taken for dissemination of orders, preparation for battle, movement prior to crossing the start line and advance rates and, in addition, for extra events such as obstacles, problems or decisions affecting timing.

The data categorisations used included conditions of operations, certain qualitative factors (such as terrain & weather), capabilities and trends in forces (navigation, fatigue & friendly fire to name a few) and finally command style of forces including "command caution[5]", which proved to be a significant factor in the analysis.

1.3 Foci of analysis

From previous HA (Watson & Rowland, 1987, and Rowland, Keys & Stephens, 1994) studies of daily advance rates, opposed and unopposed, and of breakthrough at the operational level, it was decided that the most useful initial analysis to meet the purposes of this study were:

- The distribution of times taken between the issue of orders by corps and the start of attack by each division in the corps.
- The distribution of magnitudes and rates of advance achieved in comparison with those intended.
- The problems encountered in each operation.

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[2] The appendix lists all the operations studied for the analysis conducted in this paper. For further information on the historical context of each operation, please see (Rowland & Tilley 2003).

[3] Operational Level has been used here as meaning the level above Tactical (Platoon-Battalion level) and below Strategic (Regime Level), which is consistent with previous work done in this area. This is however different from the current MOD definition.

[4] The total varies according to the definition. 10 is the basic set of operations, while 14 is the set including the expansion of some operations to include other offensives or separate corps.

[5] The definition for 'Command Caution' used in this paper is given, in Rowland 1990, as: "Command level behaviour, especially above brigade level, which is related to the less aggressive use of forces, particularly of armour, in the offensive. This behaviour has been characterised by the use of significantly higher force ratios, by the reluctance of the commander to seize or exploit opportunities, and by the avoidance of risk generally."

These three aspects all offer new information useful for modelling or wargaming and are complementary to the findings of earlier studies. Consideration of these and their use will also hopefully serve to prompt discussion of further analysis and/or data collection.

2. Time From Issue of Orders to Start of Attack

2.1 Corps Orders to Start of Divisional Attack: At the Start of Operations

The ability of a formation to respond to the issuing of orders[6] is a key driver of the timeline of an operation and indeed of the agility (readiness for motion) of that formation. Analysis indicates a strong relationship between the response time to issue of corps orders and the distance, *x* km, a formation needs to reach the start line of a divisional attack (see Figure 1). This relationship took the form (where T_1=*Time from Corps Order to Attack*):

$$T_1 = (21 + 0.77x)\ hrs \quad (1)$$

Although the sample of 17 divisional attacks available is not large it does include formations with both low and high experience and it appears an interesting observation that there is little residual spread within the results to associate with this. Most variation does seem to already be accounted for. A larger sample may, however, allow estimation of any such experience effect that may exist.

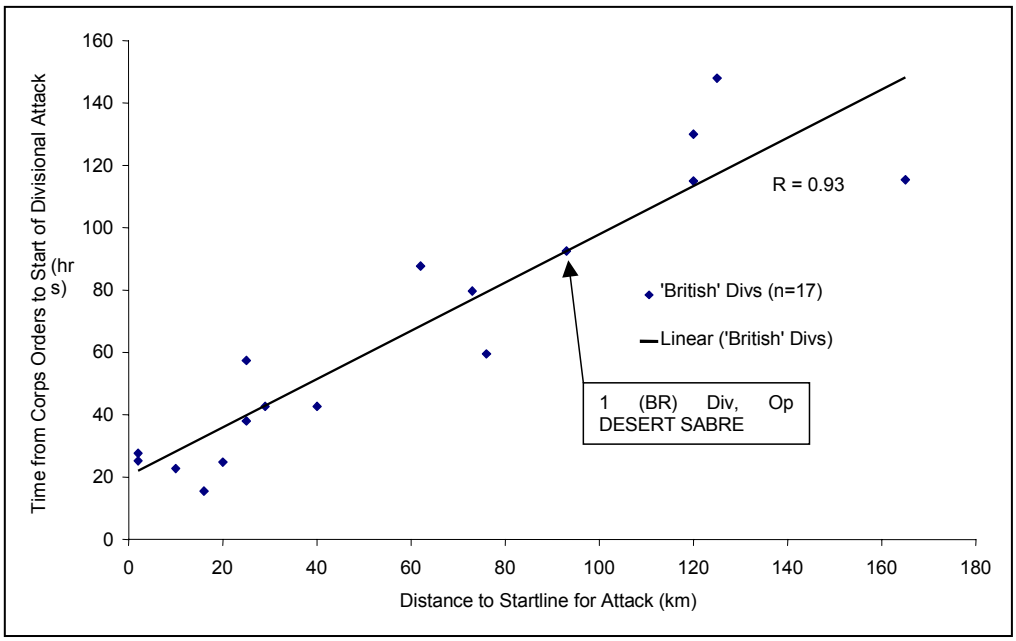

Figure 1 – Corps agility and deployment distance[7]

It is relevant to note that 1 (BR) Div[8] in the 1991 Op DESERT SABRE[9] (at 93km, 92.5hrs) actually lies on the regression line and thus does not differ markedly from the WWII cases over 40 years before.

[6] The difference in time between the issue and receipt of orders has not been studied separately. In many cases it was very low as when issued directly at a corps 'Orders' group. In at least one case, (Op SUPERCHARGE II-See Appendix) it was significantly longer (possibly 33hrs until the NZ corps/div HQ received the orders).

[7] Some divisions, in the same Corps had different distances to move and times of start, hence there are 17 points for British divisions critical to timing.

[8] 1st British Armoured Division

[9] Gulf War 1991

2.2 Divisional Orders to Start of Attack: At the Start of Operations

Examining the time between the issue of *divisional* orders and start of attack, but still against the same distance base as above, the data appeared superficially more spread out than the data on corps orders.

The basis for this spread appears to be whether divisional orders were issued before or part way through the move to the start-line. Most of the sample appear to be divisional orders issued before the move, which show a mean delay of 10.5 hours after the corps orders, with a similar gradient (0.77) to the corps level case, this is shown in Equation 2 (where T_2= *Time from Divisional Order to Attack*):

$$T_2 = (10.5 + 0.77x)\ hrs \quad (2)$$

The remainder of the sample appeared to be two sub-groups with orders issued during and after the move but the numbers are too small to be definitive.

2.3 Corps Orders to Start of Divisional Attack: During Operations

Whilst a useful sample of initial orders to action times was obtained for new orders issued during operations the inadequacies of some formation records meant that there were problems in building adequate samples. In order to gain as much as possible for this part of the study, the agreed sample was stretched from available secondary sources by inclusion of extra offensive actions (either extensions of those selected or from counter-attacks by the defence, see Appendix A). The sample thus accumulated totals of 22 times from the issue of corps orders to their divisions crossing the start line, but most of these were clustered at very low distances (20km or less) with three others at 30, 70 and 87km. The sensitivity to the inclusion of the two upper points (by distance) was tested and it was not significant.

Although this is only a small sample it appears that there is an upper group (by time) clustered around (2km, 10hrs) which can be separated from the regression analysis. All of this group (by time) appear to have been associated with planning in advance for a battle to take place at a particular time of day (e.g. two early night attacks, three soon after first light), rather than moving as soon as possible after issue of orders. If these upper cases are excluded from the regression as having a separate, deliberately chosen, time element, then the remaining sample of 15 cases gives R = 0.87 and (where T_3= *Time from Corps Order to Attack*):

$$T_3 = (3.7 + 0.49x)\ hrs \quad [10] \quad (3)$$

2.4 Divisional Orders to Start of Attack: During Operations

The corresponding divisional times (discounting the upper group of points as above) came from a partly overlapping sample, either because of lack of data on divisional order times or because of relatively detailed operations conducted on divisional initiative rather than in response to corps orders. Analysis of this sample of 13 cases gives R=0.89 and (where T_4= *Time from Divisional Order to Attack)*:

$$T_4 = (2.9 + 0.17x)\ hrs \quad [11] \quad (4)$$

2.5 Comparison With Data From Op DESERT SABRE: During Operations

Using collected radio logs and then Brigadier Cordingley's personal account (Cordingley, 1996) it has been possible to derive some further times from issue of orders to the start of subsequent attacks during Op DESERT SABRE after the initial launch of the offensive[12]. These are compared with the times derived from WWII operations for short distance moves, in Table 1. Although these are only limited samples for the Gulf conflict, they show no indication of any significant change since WWII.

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[10] Or R=0.88, T_2=4.6 + 0.48x hrs if excluding 21 Panzer Division (German). Since this sample looks mainly at UK Divisions, we present this equation as an alternative to Equation 3.

[11] Similarly without 21 Panzer Division, at T_3=3.1 + 0.17x.

[12] Which is included in the main sample.

Time From	WWII Samples	Desert Sabre sample[13]	Desert Sabre sample size
Corps orders to Div attack	4.7	4.5	2
Div orders to Div attack	3.3	3.8	4

Table 1 – Comparison of orders to start of attack times (in hours): WWII and Gulf War

3. Achievement of Planned Moves

In most of the offensive cases studied, the attack forces achieved their planned moves to contact in time, despite the sample including major moves and several instances of traffic congestion[14]. However, once in contact the advances achieved generally fell short of those planned in both distance and speed. Table 2 summarises this by the Corps rates of advance for the offensives studied.

In 50% of cases studied the advance took at least twice the time planned. The faster ones included one where an unexpected breakthrough was achieved and successfully followed up[15] and two pre-planned break-ins[16]. These results are based on a limited sample and there could be bias in it. The sample had omitted a number of clearly unsuccessful offensives so any bias is likely to be towards faster advances[17].

Based on this sample and measuring achievement either by time taken compared to plan or by distance advanced, compared to plan, the distribution[17] can be represented as normally distributed about a mean of 45% of the expected advance. The upper and lower quartiles are 70% and 22% respectively (see Table 2). The left-hand column of Table 2 shows how far their total planned advance in the operation was.

A similar analysis of total daily advances, irrespective of time taken compared to total planned advance showed a mean of 66% of the planned daily distance achieved, and quartiles of 42% and 88% achievement respectively, see Table 3.

[13] Precise distances of Op DESERT SABRE are not known, but as they were short moves 2km has been taken as basis for comparison.

[14] The major exception, due to traffic congestion, was for the armoured regiment required to support 185 Brigade's attack towards Caen on 6th June 1944 (D-Day). This was due to congested beach exits and the construction of minefields. Even here, the delay may have been avoidable as the initiative shown by the supporting SP guns for the same operation exemplified; they risked the minefield being dummy, based on visual evidence, and successfully reached their RV in time.

[15] Interestingly in each of these cases the Lt. General O' Connor Was the Corps Commander

[16] Although these were close to the planned time, the exploitation forces and hence overall advances were not.

[17] Op COMPASS & Op DESERT SABRE were also excluded from the sample for these results as it was found they had other factors present, which could skew the analysis.

Operation	Corps[18]	Distance % of Plan Achieved[19]	Rate % of Plan Achieved[20]
Alam Halfa		68	36
C/Attack Op BERESFORD		90[21]	77
SUPERCHARGE I	XXX		
	& X	67	13
PUGILIST (NZ)		10	10
SUPERCHARGE II	NZ		
	& X	77	37
STRIKE		-	33
OVERLORD (185 Bde)		50	50
BLUECOAT	VIII	100	100
	XXX	100	13
SUPERCHARGE IV		99	81

Table 2 – Achievement of total planned advance rates in contact in time

Operation	Corps	Planned Daily Advance (km)	Actual Daily Advance (km)	Percentage Daily Advance Achieved
Alam Halfa		38	26	68
C/Attack Op BERESFORD		4.8	2.8	100
SUPERCHARGE I	XXX	5.5	5.5	100
	X	3.5	0.5	14
PUGILIST (NZ)		30	2.5	8
SUPERCHARGE II	NZ	4.5	2.5	100
	X	12	12	71
STRIKE		34	17	50
OVERLORD (185 Bde)		14	8	57
BLUECOAT	VIII	6	6	100
	XXX	4	1.6	40
SUPERCHARGE IV		N/K		88

Table 3 – Achievement of planned daily advance rates in contact

[18] The name of each Corps is given in shorthand, i.e X= 'Ten Corps', NZ='New Zealand Corps'.

[19] Distance advanced as percentage of the distance it was planned to advance during the operation.

[20] Percentage of the planned rate of advance achieved during the operation.

[21] Objective briefly achieved by one bde then troops withdrawn to intermediate positions.

4. Review of Problems and Sources of Delay

The consistent themes of obstacle problems and other sources of delay in the offensive actions studied are outlined below and complemented by comment on their nature and effects.

4.1 Command Caution and Recce[22] Style

Reasons for the slow advances (shown in Table 2 & Table 3) varied; attack (command) caution[5] was apparent as a major feature in several (approximately 60% of operations studied). Apart from breakthroughs not followed up, the one achieving its planned rate took risks and achieved a breakthrough. Despite the steps taken to muster forces and possibly achieve surprise in the others, risk-taking became muted as the offensives started (notably PUGILIST, SUPERCHARGE II, STRIKE, 185 Brigade (Bde) Normandy and BLUECOAT XXX Corps). Once the attack became hesitant it also gave the defence more time to redeploy and reinforce, as noted in PUGILIST (reinforcement), SUPERCHARGE II (re-deployment), 185 Bde (reinforcement and counter attack) and BLUECOAT XXX Corps (reinforcement).

Previous studies have produced tentative evidence at the operational level for 'command caution' for armoured advances and for the value of aggressive attack recce in the advance (Watson & Rowland, 1987, and Rowland, Keys & Stephens, 1994). Given that the latter was also associated with a certain command style ('recce pull[23]') it was likely that the two were associated.

4.2 Other Command Related Problems

Quite distinct aspects from those discussed above occurred as problems in several of the operations studied:

- Command interactions (between different commanders at different levels, Army/Corps/Division) were noted as possible problems in 50% of those cases studied and as favourable in just one case.
- A variety of command problems, including confusion, lack of co-ordination and loss of direction, were identified in 67% of operations but only in serious combinations in two cases (Op BERESFORD and SUPERCHARGE I).
- Problems in terrain appreciation from available data, including air photography, can be related to 33% of the operations studied.
- Congestion is a feature found at some stage of each operation studied and has been the most regular problem noted. Its general nature has been as an obstacle to overcome, sometimes causing delay, sometimes with its effect aggravated by minefields.
- There were problems associated with minefields in 50% of operations studied. Since they are to be expected as part of combat, it is the effects and associated confusion caused thereby that are relevant to the study. A variety of the problems noted included minefields being more extensive than at first expected, delays in clearing minefields, errors in marking minefield gaps and the consequent grouping of forces in time for attacks.
- There were identified and recorded instances of 'friendly fire' in 40% of the operations studied, both air to ground and ground to ground. However in most cases this did not cause significant delay.
- Other causes of occasional problems were classified as communications, logistics and officers missing in action or becoming casualties. No patterns of problems were found for the other categories considered.

[22] Reconnaissance

[23] The attack commander's willingness to be flexible in changing the plan based on the intelligence gained from reconnaissance.

5. Conclusions

5.1 Time Taken from Issue of Orders to Attack

In the approach to battle, the times from corps and divisional orders being issued to the start of an attack appear to be related to the distance to move to the start line but also appear to be insensitive to experience. Preliminary comparisons of WWII and Gulf War (Op DESERT SABRE) times give no evidence of a change in these times over this period.

After factoring out such cases as deliberate delays, the average time taken from issue of orders to commencement of attack, is summarised in Table 4:

Time From	Start of Operation	Within Operation
Corps Orders	21 + 0.77x	3.7 + 0.49x
Div Orders	10.5 + 0.77x*	2.9 + 0.17x

Table 4 – Time (hours) taken from issue of orders to start of attack (x = distance to start line in km)

(Note: * For div orders before the move)

When starting new operations with very short distances to the start line the average times for corps orders to start is estimated at 21 hours, and half that for divisional orders. On the other hand, for new orders within continuing operations these times reduced to approximately 4 and 3 hours respectively.

The effect of distance was linear within the range of values (from 10-100km) tested. At 100km distance, the corresponding start of operation times increased to 98 (corps) and 88 (divisional) hours or for new orders in ongoing operations, 53 and 20 hours respectively.

5.2 Advance Rates

An initial examination of advance rates within the first day has provided realistic estimates of these, which can be extended to other situations with the aid of previous data on daily advances.

Advance rates in combat in terms of time averaged 45% of those planned, although total daily distances advanced averaged circa 66% of those planned - eventually. Thus in many cases advances were either curtailed or failed to take their objectives. The effect of delays built up as the defence gained time to reinforce or to re-deploy.

5.3 Problems and sources of delays

5.3.1 Command Caution

The current study, by following the course of decisions at the brigade and divisional level, has begun to expose examples of the mechanisms by which command caution has thwarted successful offensives in several cases:

- Successful advances and breakthroughs were associated with those cases where the attack commanders were prepared to take risks, while excessive caution led to opportunities being missed.
- Recce style, particularly the aggressive use of attack recce, is closely associated with command style. The association is the extent to which ‘recce-pull’ is allowed to aid the offensive.

5.3.2 Other Problems

Review of the other causes of delay and associated problems in the examples studied found that many of these were command related. These problems were categorised as:

- Command interaction produced more subtle effects than ‘Command Caution’ but was a frequent phenomenon.
- Terrain appreciation or lack of which was attributed to problems in planning and conducting some operations.

- A suite of command-related effects grouped as confusion, lack of co-ordination and loss of attack direction.
- Congestion, which occurred to some extent in every operation studied, sometimes delaying activities enough to prevent success.

In addition to these there were problems caused directly by minefields; the effects of uncertainty and extent of the minefield, and an extra factor confusing movement and co-ordination were noted.

5.4 Implementation

The results and conclusions from this work, which are to be incorporated into models of combat simulation, include:

- The Corps to Div and Div to Bde times from receipt of orders to action as planning times to be used to update models of combat simulation. These times can then be used to delay the generation of deliberate plans from these command levels.
- Calibration of the times from the crossing of start lines and use of these times to slow forces in the contact and out of contact phases.

References

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[24] DOAE (Defence Operational Analysis Establishment) and DOAC (Defence Operational Analysis Centre) are two of the predecessor organisations to Dstl. Address for Dstl given with authors' address.

Appendix A- Case-Studies

Name of Operation[25]	Date	Place	Attacker	Defender	Max Scale	Terrain
Op COMPASS	08-12.12.40	Sidi Barrani	British	Italian	Corps	Desert
Op SUPERCHARGE[26]	01-04.11.42	Alamein	British Commonwealth	German & Italian	Corps	Desert
Ops PUGILIST & SUPERCHARGE II[27]	02-27.03.43	Tebaga	British & New Zealand	Italian then German	2 Divs./Corps	Desert & Mountainous
Op STRIKE[28]	05-07.05.43	Tunis	British & Italian	German & Italian	Corps +	Open & Mountainous
Op BLUECOAT	30.07-09.08.44	Normandy	British	German	Corps	Bocage
Op SUPERCHARGE IV (The Great Swan)[29]	29.08-03.09.44	France & Belgium	British	German	2 Divs	Open
OP BERESFORD (Alam Halfa)[30]	01-02.09.42	Alam Halfa	German	British	Corps/Div(+)	Desert
Op YELLOW	14-31.05.40	France & Belgium	German	British	BR 3 Div	Open
Op OVERLORD (Normandy)	06.06.44	Periers Ridge	British	German	(185) Bde-Div	Open
Op DESERT SABRE	25-28.02.91	Kuwait	British	Iraqi	1 Div	Desert

[25] Or name operation is best known by.

[26] This case study was extended by the inclusion of data on the earlier phases of this allied offensive at Alamein.

[27] This case study was extended by the inclusion of the subsequent X and NZ Corps operations once SUPERCHARGE II was halted.

[28] This case study was extended by the inclusion of the changes of roles for the divisions as Tunis was captured.

[29] This case study was extended to include the Seine Crossing (Op Neptune) proceeding it.

[30] Including data from other sources on Op BERESFORD and the NZ Division's attack on the DAK extended this case study.