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GIAMPIERO BRUNELLI



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Vienna, Monumento equestre al Principe Eugenio di Savoia, particolare.
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Battle plans in the 17th century on the example of the ‘Ordres de bataille’ from Riksarkivet – Focusing on the Armies of Western Europe*

by MARIUSZ BALCEREK **

ABSTRACT: This article analyses 17th-century warfare through 499 illustrations of battle formations from the Swedish National Archives (Riksarkivet). We examined each illustration based on several key elements: symmetry; the depth of battle patterns in terms of main throws and lines; the width-to-depth ratio; the relationship between cavalry and infantry positioning; the spacing of cavalry and infantry; the formations used for both cavalry and infantry; and the number of units involved. We utilised the LOEES method within the Gretl statistical package to analyse the results. Our findings revealed that perfectly or nearly symmetrical formations were predominant. The median for the main throws was 2 and 3 for the lines, with both exhibiting decreasing trends. An analysis of the width-to-depth ratio for formations indicated that, in the 17th century, the median was 6:1. We observed an upward trend in all formations until 1677, after which there was a return to deeper formations. Regarding the formation of cavalry in relation to infantry, commanders most often employed a mixed pattern (46.69%). We noted fluctuations in the trend of spacing within cavalry and infantry formations. This trend persisted until the 1670s, when formations without this spacing element began to dominate. Formations continued into the 1630s in cavalry and into the 1650s in infantry. The number of units ranged between 50 and 100. Only from the mid-1670s onward did we notice a significant increase in the number of units included in formations.

KEYWORDS: BATTLE PLANS; ART OF WAR; 17TH CENTURY; NATIONAL ARCHIVES (RIKSARKIVET); THEORY OF THE MILITARY REVOLUTION

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Introduction

War has always played a significant role in human development. Studies on chimpanzee behaviour indicate that the history of conflict predates *Homo sapiens* (Wilson and Glowacki 464–508). Therefore, a detailed analysis of fighting methods is essential for understanding the evolution of our civilisation. One of the most important aspects of military history is the art of war. How can we study this subject? One practical approach is to analyse the battle plans before the fight.

Significant changes in the art of war occurred during the 17th century as part of a broader process known as the military revolution. This article aims to answer the question: How did the art of war evolve in 17th-century Europe, focusing on the Armies of Western Europe? To address this question, we will analyse key elements, particularly the arrangement of troops before battle. We will begin by describing iconographies that depict battle plans and then statistically examine the results obtained from this analysis.

Battle plans from Swedish National Archives (Riksarkivet)

The analysis is based on six albums kept in the Swedish National Archives (Riksarkivet) in Stockholm. Of these, five are in the section *Ordres de bataille 1600–1749* (SE/KrA/0438), a special collection consisting of albums with battle orders. The sixth is in the section of the Ehrensvärd family archive “Ehrensvärdska arkivet”, in the collection “Tosterupssamlingen” (SE/KrA/0289/I). Ehrensvärd is the surname of a noble family in Sweden that produced many soldiers, which perfectly explains the presence of an album with orders in the collection (Hildebrand and Hammarskjöld 412).

Only two Battle Plan albums have titles. *Apographum bellorum et victoriarum ab anno 1620 ad 1717*, that is, *Apograph of wars and victories from 1620 to 1717*, is the title of album no. 2 (SE/KrA/0438/2). *Campement der Schweden und Dänen*, that is *Campement of the Swedes and Danes*, is the title of album no. 3 (SE/KrA/0438/3). In the latter case, the title was written in pencil on the manuscript's cover. We do not know when this occurred. Given the form of the writing, it should be considered a secondary title, which may have originated in the archives. It was inspired by the titles of individual battlefield boards, which began in this manner.

Only in one case can the author be identified. Eric Johnsson Dahlbergh (1625–1703) was a Swedish soldier, engineer, and draftsman (SE/KrA/0438/1). In 1676, he became general inspector of fortifications, and in 1693, field marshal (Ericsson 616; Stade 11). The album with battle formations was a New Year's gift to Charles XI, King of Sweden, in 1687. It was the subject of several articles by Mariusz Balcerek ('Liczebność' 77–93; 'Kawaleria' 21–103; 'Polskie' 93–108; 'Szyk' 149–64; 'The Battle' 1377–88). The Price can also be found on *Campeement der Schweden und Dänen*, that is, *Campeement of the Swedes and Danes*, the title of album no. 3 (SE/KrA/0438/3). On the back cover, someone wrote '60 d', likely 60 daler. The annotation was likely made by the seller or buyer – in this case, an archivist. We do not know exactly when this occurred. If these were silver coins, then after converting the silver from the coins, we get 1,530.27–1,541.838 g of the bullion (in the years 1676–1830, 1 daler: 25.6973 g of silver and in 1831–73: 25.5045 g, Edvinsson 'Swedish' 50), which today would be worth €1,744.51–1,757.70 (1 g of silver – €1.14).¹ The manuscript was written after 1689, probably in the 17th century.



Fig. 1. Battle plan of the Polish Lithuanian army in the Battle of Kirchholm in 1605, SE/KrA/0438/1, fol. 44.

The situation regarding album no. 2 (SE/KrA/0438/2) is more complex. The author is identified as F. M. P., a lieutenant based in Dresden, but we have been unable to determine his identity. The manuscript was created after 1717, as the last illustration shows the layout from that year.

Notably, a second copy of the manuscript is housed in the Saxon State Archives (Sächsisches Staatsarchiv, 12884 Karten, Risse, Bilder, Nr. Schr 001, F

¹ Price for 1g of silver on 17th September 2025 (<https://www.bullionvault.com/silver-price-chart.do>).

029, Nr 014). A third copy is in the Library of Congress (LCCN 90131122, Jefferson, D247. F2 1725 fol. LJ239). The Swedish copy came to the Riksarkivet after being purchased at an auction in Leipzig on 18th October 1853. The album cost 9 Thalers and 13 Groschen, or 9.27 Thalers (1 Thaler = 30 Groschen). Converting the coins into pure silver yields 154.49382 g of the metal (1 Thaler = 15 g of silver; Shaw 382). This means the manuscript would be worth €176.12 today.

The Price can also be found on *Campement der Schweden und Dänen*, that is, *Campement of the Swedes and Danes*, the title of album no. 3 (SE/KrA/0438/3). On the back cover, someone wrote ‘60 d,’ likely 60 daler. The annotation was likely made by the seller or buyer – in this case, an archivist. We do not know precisely when this occurred. If these were silver coins, then after converting the silver from the coins, we get 1,530.27–1,541.838 g of the bullion (in the years 1676–1830, 1 daler: 25.6973 g of silver and in 1831–73: 25.5045 g, Edvinsson ‘Swedish’ 50), which today would be worth €1,744.51–1,757.70 (1 g of silver – €1.14). The manuscript was written after 1689, probably in the 17th century.

We know little about untitled album number 4 (SE/KrA/0438/4). It was likely written in the mid-18th century. The cover features a note from October 1880 by a name unknown to us, Gustaf Allyklan/Allyhlan. In the table of contents, the author underlined the Swedish battle formations in blue pencil and the foreign ones in red.

Album no. 5 (SE/KrA/0438/5) has an interesting story. The first owner of the album was Nils Roll (Roelle, 1660–1720), mayor of Christiana (now Oslo), who then gave it as a gift to Colonel Storm (“Monsieur de Stoerm Collonel d[e] Infanterie au service du Roy”) (Sprauten 301). On the back of one page, we can read that Storm served in the Trondheim Southern Regiment (“Mons de Storm Collonel d[e] Infanterie dy Regement de sydre drontheime”), i.e. in the 2nd Trondheim Infantry Regiment. The colonel and chief of this unit from 1716 was Christian Ulrik Storm (–1727), i.e. nine years after the latest dated battle plan – 1707 (Elgenstierna 723; Ovenstad 451). We do not know where Mayor Roll got this album. As a civilian, he was not interested in such topics, and it is unlikely that he was its author.

The plates in the album (SE/KrA/0289/I) from the “Tosterupssamlingen” collection are dated by the Riksarkivet to the 1690s. This is likely because the last illustration depicts the formation of the armies of the Great Coalition in the war against France at Maine in 1692 (no. 54). Interestingly, the illustrations with the

formations in the manuscript were cut out from another one and pasted here. It shows the most significant similarity to album no. 1 (SE/KrA/0438/1; almost 84% perfect match), by Dahlberg. The Riksarkivet dates the album's creation to 1753–1754. A note added to the album tells us that the manuscript was purchased in September 1936 from the Thulin and Ohlsons antiquarian bookshop in Gothenburg, Sweden, for 20 Swedish kronor.² Converted to the gold content of the coins (1 krona = 0.4032258 g of gold; Edvinsson 'Swedish' 53), the result is 8.064516 g of pure gold. Today, this would be worth €804.03 (1 g of gold = €99.70).³ The antique shop acquired the work at auction a year earlier.⁴

The album features iconic battle depictions from the most significant conflicts of the 17th century in Europe. Among these are the Eighty Years' War (1568–1648, notable events in 1601), the Swedish–Lithuanian Commonwealth War (1600–1629), the War of the Jülich Succession (1609–1614), and the Thirty Years' War (1618–1648). Additionally, it includes the Franco-Spanish War (1635–1659), the Great Northern War (1655–1660), the Fourth Austro-Turkish War (1663–1664), the Franco-Dutch War (1672–1678), the Scanian War (1675–1679), the Great Turkish War (1683–1699), the Glorious Revolution (1688–1690), and the Nine Years' War (1688–1697), ending with the Great Northern War (1700–1721, with events leading up to 1700). Notably absent from the album are the English Civil Wars (1642–1651) and other conflicts such as the Austro-Turkish Wars, as well as wars involving the Polish-Lithuanian Commonwealth against Russia, Turkey, and the Cossacks, among other land wars.

The six albums contain 832 iconographic representations of battle formations from the 16th to the 18th century. After narrowing this collection to 1601–1700, we obtained a resource of 660 elements. Additionally, after rejecting similarities (the exact width-to-depth ratio, number of projections and lines, occurrence of intervals and number of units in the formation) and illustrations showing only cavalry or infantry, the number of elements for analysis dropped to 499. Out of the 499 representations of formations, we have 189 battle schemes – 37.88% and 310 non-battle – 62.12% (Table 1). As can be seen, non-battle schemes were as crucial for the authors of the albums as those before battles.

2 The antiquarian bookstore is still in operation today, <https://thulinohlson.se/>.

3 Price for 1g of gold on 18th September 2025 (<https://www.bullionvault.com/gold-price-chart.do>).

4 A comparative analysis of all six albums will be presented in a separate article.

Table 1. Albums with battle orders (BO)

No.	Signature	Years	BO Total	BO 17 th century	BO with- out dupli- cation	battle	Other
1.	SE/KrA/0438/1	1600–1686	281	254	248	68	180
2.	SE/KrA/0438/2	1620–1717	155	112	111	55	56
3.	SE/KrA/0438/3	1655–1689	19	19	18	8	10
4.	SE/KrA/0438/4	1620–1749	204	115	15	3	12
5.	SE/KrA/0438/5	1620–1707	105	92	90	51	39
6.	SE/KrA/0289/I/4	1626–1689	68	68	17	4	13
in total			832	660	499	189	310
%						37,88	62,12

Tab. 1. Source: Made by the author

Literature

The inspiration for the analysis of the battle plans from Riksarkivet and writing this article was the text by Mariusz Balcerek, who conducted a study of the formations from Erik Dahlberg's album (SE/KrA/0438/1). He was the first to analyse not a few or a dozen patterns but over 250 for 1600–1686. The statistical method allowed him to trace the changes in the art of war through the prism of battle schematics, which is impossible using classical methods based on analysing a few cases. He studied the symmetry and depth of the battle plans, the ratio of cavalry to infantry in them, and the occurrence of intervals and higher formations ('The Battle' 1377–88).

We used this method, making minor modifications. We conducted a much broader review of the literature than Balcerek. We used books and articles from recent decades on the art of war in the early modern period, whose authors described battle plans from the 17th century. Due to the need to compare the results of our analysis, we preferred synthetic studies because we could find the sum-

mary conclusions from them. Works on the theory of Military Revolution, initiated by Michael Roberts in his speech in 1956 (*Essays*; 'The Military' 13–35), turned out to be very important for us. Many researchers commented on, criticised, corrected and supplemented it. They devoted separate works to it or only referred to it in analysing other issues in the field of military history. One cannot ignore this issue when writing today about changes in the art of war in the 17th century. The authors most frequently cited in this text include: Geoffrey Parker ('The "Military Revolution,"' (1976) 195–214; *The Military Revolution. Military*; 'Dynastic War' 148–66; 'The "Military Revolution" (2018) 37–54), John Lynn ('The Growth' 568–85; 'Tactical' 176–91; 'The Pattern' 1–27; Giant; 'The Treatment' 131–65; Battle; 'States' 167–88; 'Recalculating' 117–47; 'The Trace' 169–99), David Parrot ('Strategy' (1985) 7–26; 'Strategy' (2018) 227–51), Brent Nosworthy (*The Anatomy*; 'Dutch' 6–12; 'The Advent' 10–36), Jeremy Black (*European Warfare 1660–1815*; *European Warfare 1494–1660*), Frédéric Chauviré (*Histoire*; *The New Knights*). Gunnar Artéus, who published his work on the tactics of the Swedish army against the European background in 1700–1712 in 1972, did not address the theory of Military Revolution (Artéus). Despite this, his book is very valuable on the subject discussed here, as is best evidenced by its frequent citations.

Research method

When analysing the battle orders, we used Mariusz Balcerek's research model ('The Battle' 1379–80), which we modified and supplemented. We analysed the following elements: symmetry; depth of battle pattern in the form of main throws and lines; the ratio of the width of the order of battle to its depth; the relationship between the cavalry and the infantry positioning; intervals in cavalry and infantry; formations in cavalry and infantry; and the number of units. We modified the interval assessment and added the number of units to the analysis.

1. *Symmetry*: We were interested in the distribution of units in the pattern. Was it perfectly symmetrical, almost symmetrical, or asymmetrical? This involved counting all units in the schemes, which comprise 39,215 rectangles, of which there is an average of 79 per battle plan. A single defect in the array was enough for the variety not to be considered perfectly symmetrical. In the case of asymmetry, the lack of order had to be visible at first glance. Balcerek

placed three types of arrangements on one Y-axis with one function line. We decided to show each type on a separate graph. We agreed that this would give us a clearer picture of the changes taking place.

2. *Depth of battle pattern in the form of main throws and lines*: We analysed the number of main lines and all lines in the formation. We considered units arranged in two or three lines using intervals or at an angle (echelon) as one throw. As a result, we obtained armies in formations arranged in 1–8 throws. In the case of lines, we counted them all. Infantry placed in a Dutch brigade usually creates 6 lines, in a Swedish brigade 4, and in the case of a Spanish *tercio*, we have 3. We did the same with the cavalry. The smallest number we obtained was 1, and the largest was 22.
3. *The ratio of the width of the order of battle to its depth*: The research method is straightforward. We measured in the open graphics program Gimp, just like Balcerek. We performed a simple calculation, which consisted of dividing the width by the depth of the battle plan. We rounded the results to whole numbers.
4. *Cavalry to infantry ratio*: We studied the arrangement of cavalry in relation to infantry in formation. Like Balcerek, we distinguished three types. As the name suggests, the classical arrangement refers to the formation of the ancient Greeks, Macedonians, and Romans, where the infantry was in the centre, and the cavalry was on the wings and in the rear. We treated minor changes to this scheme in the form of dragoons on the wings or several squadrons of cavalry in the centre as an almost classical arrangement. A greater deviation from the classical rule was considered a mixed formation.
5. *Intervals in cavalry and infantry*: Intervals are gaps in the line of infantry battalions or cavalry squadrons, into which units from the second line can enter. Balcerek recognised every manifestation of intervals. As a result, there were intervals in almost all battle plans. This forced us to apply restrictions when recognising the presence of this element. We considered intervals only when at least half of the formation (cavalry or infantry) was set up using them. We also rejected variants where the gap between battalions or squadrons was smaller than the width of the unit (pseudo intervals).
6. *Formations in cavalry and infantry*: For us, a tactical formation is a collection of infantry or cavalry units that form a larger whole in the battle pattern. The most well-known are the infantry formations: the Spanish *tercio* and the Dutch

and Swedish brigades. The cavalry formations were less well-known, but often occurred in formations and were very similar to the infantry.

7. *Number of units*: We counted the units shown in each battle pattern separately, in the form of infantry battalions, cavalry squadrons, individual companies, banners, and even corporals. This gave a total of 39,215 units. The smallest, only 10, was the Swedish formation, formed in 1677 on the march from Bältebärga to Lund. The largest, as many as 568 units, was the Swedish formation, formed in 1630 near Stockholm.

In the case of the Swedish infantry brigade, the authors of iconographic representations of formations repeatedly showed individual corporals of musketeers. As a result, the number of units increased significantly. An example is the formation above, consisting of 568 units.

Like Balcerek, we used the Gretl statistical analysis package to process the collected data. We used the LOESS method (locally estimated scatterplot smoothing/local weighted polynomial regression model). This works perfectly for frequently changing data (Poniat 104–15; Scholtus and Müller 22–34). Moreover, we collected such data by describing battle plans in a spreadsheet. When performing the analysis in Gretl using the LOESS method, we used the default parameters: polynomial order $d=1$ and bandwidth $q=0.5$.

Data with detailed analysis results are available in a separate file in XLSX format on the Researchgate platform (Balcerek 'Battle plans (data)'). Visualisations in the form of charts in the Gretl program in the form of larger iconography in PDF format are also available on this platform (Balcerek 'Battle plans (visualisations)').

Results

The symmetry of the battle plan

Table 2 shows the percentage distribution of symmetrical, almost symmetrical and asymmetrical formations for three groups of plans: all, battle and non-battle. Perfectly symmetrical formations dominate. This applies to the groups: all (48.10%), battle (41.27%) and non-battle (52.26%). There is a significant difference compared to Balcerek's findings, where the relevant data are 56%, 64%, and 62% ('The Battle' 1381). The dominance of symmetrical formations is the

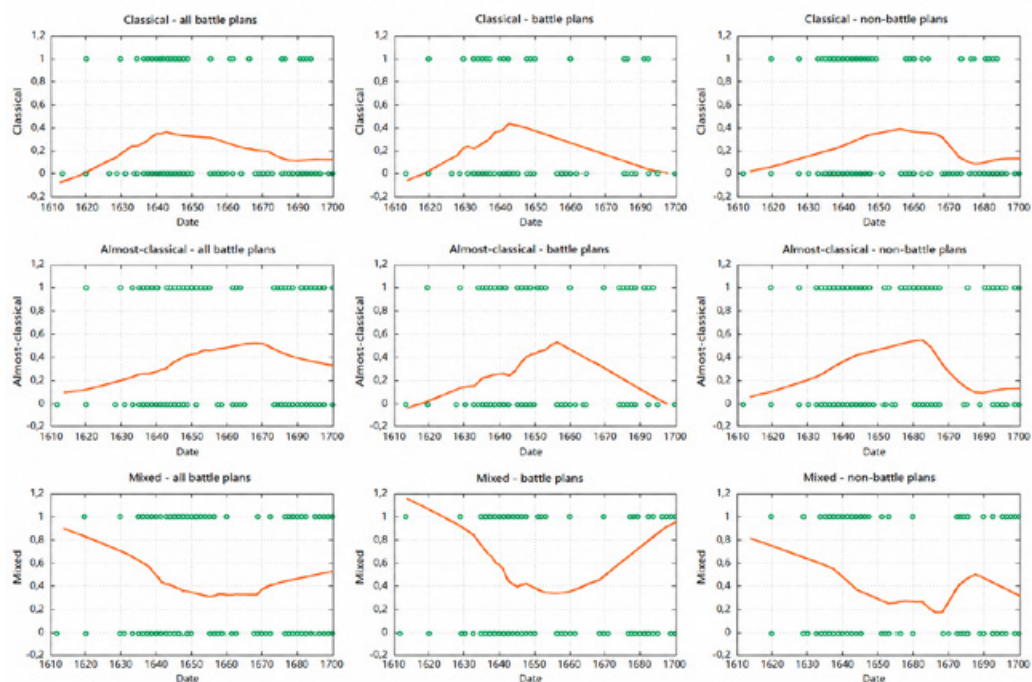


Chart 1. Sources: Made by the author

Charts 1.1.1.–1.3.3. Scatter plots showing symmetric, almost-symmetric, and asymmetric patterns for three groups (all battle plans, battle plans, and non-battle plans) over a century (values: 1 – symmetrical; 0 – no).

In charts 1.1.1.–3. showing symmetrical formations, we tend to move away from it throughout the century. In the case of all (1.1.1.) and battle (1.1.2.) patterns, we observed a halt of this trend in the 1640–1663 (all) and 1645–1660 (battle). The Graph for non-battle plans (1.1.3.) is interesting. Here, we first have a movement towards symmetry, which lasted until 1656. Then, we have an apparent decline towards formations without perfect symmetry.

In Charts 1.2.1.–3. showing almost symmetrical formations, we see a rising trend throughout the century. In the case of all (1.2.1.) and non-battle (1.2.3.) patterns, we observed a temporary halt of this trend 1640–1665 (all) and 1655–1667 (non-battle). The Graph for non-battle plans (1.2.3.) is interesting. Here, the line first climbed upwards to change direction in 1655. The trend reversed in the mid-1970s, but the line did not return to the level of 1665 until the end of the century.

On Charts 1.3.1.–3. we see a slow upward trend that shows asymmetrical style throughout the century. In the case of all schemes (1.3.1.) and battle (1.3.2.) We observed the stopping of this trend in 1640–1665 (all) and 1635–1660 (battle). Interestingly, concerning the battle plans, the line after returning to the upward trend did not reach the previous summit level. The Chart 1.1.3. looks even more interesting. There, we first see a downward trend, which lasted until 1655. Only from that moment do we record a slow increase in asymmetry.

Balcerek, analysing symmetry differently, yielded similar results ('The Battle' 1381–82). Here, too, we observe a trend of moving away from symmetrical patterns towards almost symmetrical ones. The author noted a period of change in this trend in 1644–1659, which fits very well with our results (1640–1665).

When thinking about geometry in this era, we focus on military architecture. Many researchers have pointed out that the pursuit of harmony and symmetry was also present in battle formations. Parker compared the geometry of formations to military architecture (*The Military Revolution. Military* 6). Henning Eichberg described the application of geometry in various aspects of life in the Baroque era, such as fortifications, battle formations, drills, and fencing. The pursuit of harmony can also be seen in non-military spheres, such as dance or the art of horse riding. In his opinion, the inspiration for the love of order came from antiquity (17–50). The officers in the 17th century were fascinated by geometry on the battlefield (Parrot 'Strategy' (2018) 233; Thornton 517). The geometry also appeared at parades, where manoeuvres were practised later to be performed on the battlefield (M. Roberts, 'The Military Revolution, 1560–1660' 21; Thompson 8). Infantry officers were required to use the square root, which was essential for creating infantry formations in the shape of a perfect square until the second half of the seventeenth century (Parrott, 'Strategy' (1985) 12; Parrot 'Strategy' (2018) 233; Lynn, *Giant* 475; León 23, 127–28; Szadkowski 611). The fascination with mathematical order on the battlefield can be seen perfectly through the prism of symmetry. The result of our analysis, in the form of almost 86% of perfectly or nearly symmetrical formations, is significant evidence confirming this pursuit of perfection.

In the 18th century, geometrical formations and the pursuit of symmetry were considered manifestations of the Enlightenment ideology (Nosworthy, *The Anatomy* XV, 15, 293; Olzacka 109, 115, 122). The geometry of combat formations was described in Denis Diderot's *Encyclopédie* (Lynn, *Battle*; Bousquet 64). When

forming units on the battlefield, inspiration was drawn from Isaac Newton's mechanics (Bousquet 64). The armed forces of Frederick the Great were considered an ideal example of an automated army (Bousquet 19, 226). John Lynn noted that an element of the geometrical aesthetics of the military was the culture of forbearance. This consisted of a lack of reaction to enemy fire, significantly impacting the enemy, who fled from such an army. This order was developed during arduous training and parades, where schema and geometry were mandatory (Lynn, *Battle*; Lynn, 'The Battle' 159–60).

According to Anders Engberg-Pedersen, the beginning of the decline of geometry in the military, including on the battlefield, was already visible in the 18th century (39–40, 44). At the turn of the 18th and 19th centuries, we see a widespread departure from this concept (Eichberg 40; Bousquet 83; Engberg-Pedersen 44–45).

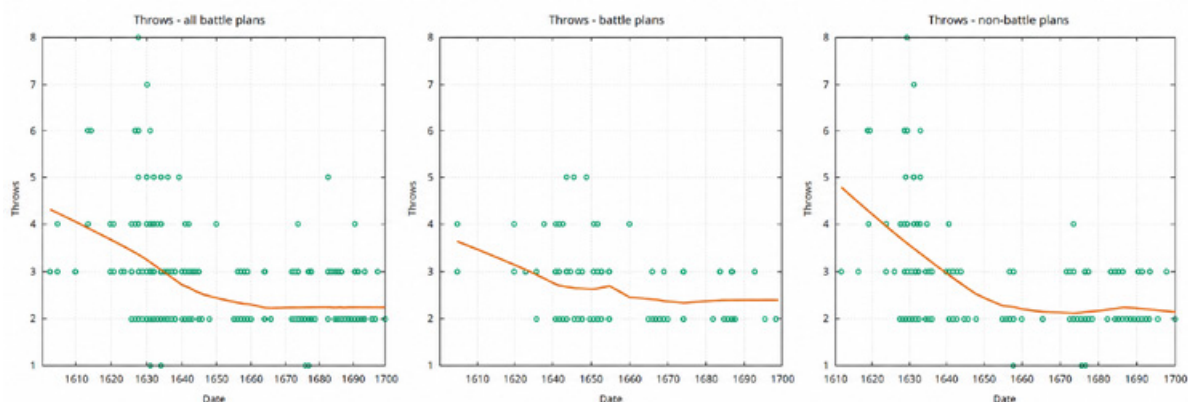


Chart 2. Sources: Made by the author

Chart 2.1 shows all the formations, and we see a slow but steady trend from 4 to 2 rolls. It was not until 1634 that the line crossed the three-roll level and then headed towards two, which it did not reach until the end of the century, although it came close. The graphs for the battle and non-battle formations look very similar. The downward trend line for the battle patterns is flatter than for the all and non-battle patterns.

The tendency to reduce the number of throws can also be seen in chart 2.1 in Balcerek's article ('The Battle' 1382). However, there was first a trend towards four throws with a peak in 1624, then it reversed. In 1634, the line crossed the level of three throws, just like in our study.

Chauviré wrote that in the 16th century, armies in Western Europe formed in one line (*Histoire*). The army formed in three lines was inspired by the art of war of the Romans (K. Roberts 5). Maurice of Orange often formed his army in three lines (Chauviré, *The New* 181). Raimondo Montecuccoli (1609–1680), an imperial commander and military theorist from the 17th century, in his treatise on war, “Trattato della guerra” (written in the years 1639–1641), wrote about the necessity of deploying the army in two or three lines to be able to count on reserves at the decisive moment (Mostarda and Ilari 269). French military theorists in the mid-17th century recommended using two throws and a reserve (Lynn, *Giant* 533; Chauviré, ‘La Maison’ 86–87). Lynn dates the popularization of three throws to 1660 (Lynn, ‘States’ 169).

Lines

The median for all formations is 3, with an arithmetic mean of 4.44 and Q1 – 2 and Q3 – 5. We noted similar results for battle (median – 3, mean – 4.42, Q1 – 3 and Q3 – 5) and non-battle (median – 3, mean – 4.45, Q1 – 2 and Q3 – 6) schemes. Battle formations were set using a slightly smaller number of lines.

Charts 3.1.–3. Scatter plots showing the number of lines of three groups (all battle plans, battle plans, and non-battle plans) over a century.

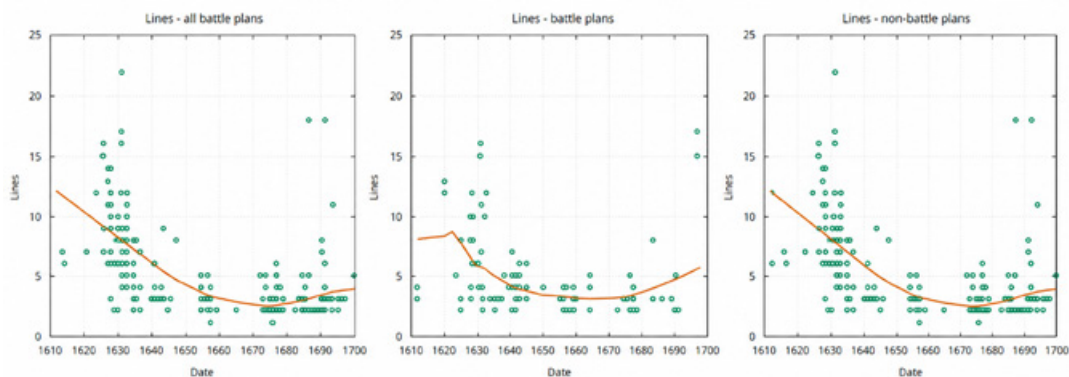


Chart 3. Sources: Made by the author

The chart for all the formations (3.1.) shows a slow but steady trend towards fewer and fewer lines throughout the century. At the beginning of the 17th century, we had almost eight lines. The level of 5 lines was reached in 1636. In 1700, we had 2.5 lines. We see similar trends in the graphs for battle and non-battle plans.

The difference is that in the case of battle patterns (3.2.), we have more dynamics than in non-battle schematics (3.3.).

In the case of the relevant Graph in Balcerek's article ('The Battle' 1382–83), we observe a different line. Similar to the graphs concerning the main throws, we also have a trend towards a larger number, which lasted until 1623 (9 lines). Then, there was a reversal of the direction of the line, which started to move towards two but did not reach it. Despite this, at the beginning of the next century, the armies of Peter I and John Churchill, 1st Duke of Marlborough, arranged themselves in three or more lines (Artéus 53–54, 56, 101–03; Strachan 18).

In this area, Turkish battle patterns stand out, diverging significantly from the others (Fig. 6). This is because the Ottoman Porte did not adopt linear tactics in the 17th century (Parker, *The Military Revolution*, Military 127; Kadercan 122).

The ratio of the width of the order of battle to its depth

The median for all formations is 6:1, with an arithmetic mean of 7.75:1 and Q1 – 5:1 and Q3 – 9:1. We noted similar results for battle patterns (median – 6:1, mean – 6.85:1, Q1 – 4:1 and Q3 – 5:1) and non-battle (median – 6:1, mean – 6.29:1, Q1 – 5:1 and Q3 – 9:1) patterns. Interestingly, battle formations have an average greater width-to-depth ratio than non-battle formations. Interestingly, the arithmetic mean result for all patterns was higher than for battle and non-battle.

Chart 4.1.–3. Scatter plots showing the width-to-depth ratio of the orders of battle of three groups (all battle plans, battle plans, and non-battle plans) over a century.

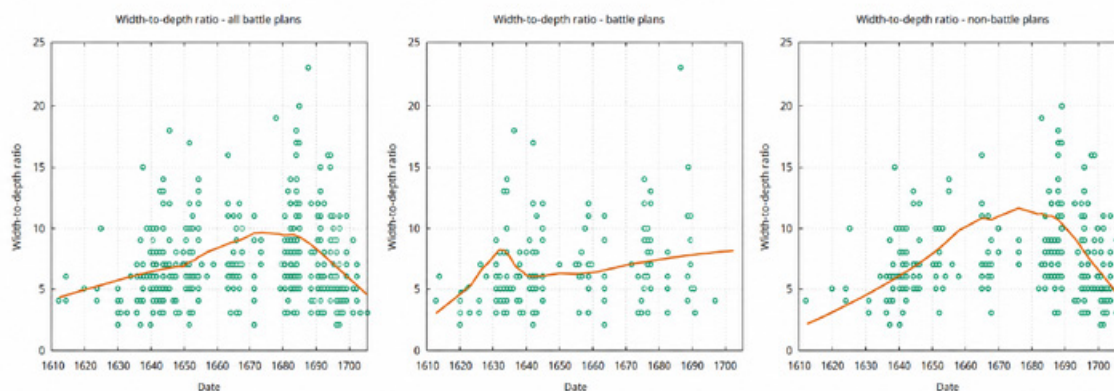


Chart 4: Made by the author

Chart 4.1. shows an intriguing trend in the width-to-depth ratio across all formations. At the beginning of the century, the ratio exceeded 4:1 and showed an upward trend that continued until 1666, reaching almost 10:1. However, beginning in 1677, we noted a gradual decline in the width-to-depth ratio. By 1700, the ratio had decreased to nearly 5:1, slightly higher than the 1601 figure. In contrast, the corresponding Graph from Balcerek's article ('The Battle' 1383) presents a different picture. It shows a slow but steady increase in the width-to-depth ratio, rising from about 4:1 to over 10:1. It must be remembered that Balcerek analysed battle plans only up to 1686, which must have impacted the course of the lines on the Graph.

In Chart 4.2., for battle-only settings, we see an upward trend in the width-to-depth ratio of the formation. However, this is not a simple increase. True, we first see a precise movement in this direction of increasing the ratio. It stopped in 1631 at 8:1. We see a shift towards deeper settings. This trend continued until 1640 (6:1) when the line began to climb again. By the end of the century, we see almost 8:1, almost three times higher than at the beginning.

On the corresponding Graph in Balcerek's article ('The Battle' 1383), we also see a trend towards an increase in the width ratio to the depth of the array. Here, we also observe a dynamic course of the trend line. At first, it climbs upwards, i.e., towards a larger ratio, but in 1620, it changes direction to the opposite, and in 1623, it changes the vector again. In 1634, we noted another change in the trend in favour of a decrease in the ratio, which lasted until 1660. From that year onwards, the line tends towards the top of the Graph.

Chart 4.3. for non-battle settings looks similar to Graph 4.1. Here, we see a greater difference between the initial state (2:1) and the final state (4:1). On the corresponding Graph in Balcerek's work ('The Battle' 1383), we see a different course of the line. Here, we have a simple course from 4:1 to 10:1.

As we can see from the graphs, the formations in the 17th century were relatively deep, and increasing the width-to-depth ratio was slow and not as simple as it seems. We can list battles that were lost due to a shallower formation of the army. A great example is the very shallow formation of Johann Tserclaes von Tilly at Breitenfeld in 1631 (Parrot 'Strategy' (2018) 232). In one of the albums, we see the scheme in the initial version as one line, which gave a width-to-depth ratio

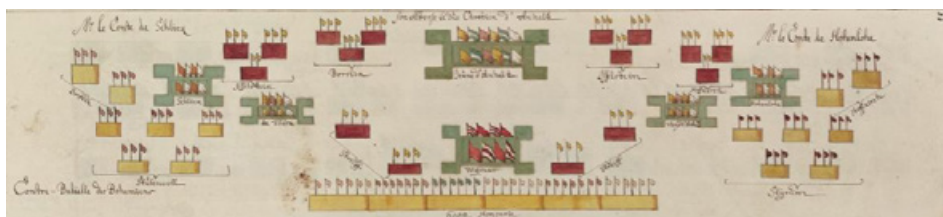


Fig. 3. Battle plan of the Czech army in the Battle of White Mountain in 1620, SE/KrA/0438/5, fol. 2.

Michael Roberts described transitioning from large infantry squares to linear formations (*Essays* 196; ‘The Military’ 13–14). He and later scholars, Parker and Parrot, described the decreasing depth and increasing width of infantry battalions in the seventeenth century (M. Roberts, *Essays* 196; Parrott ‘Strategy’ (1985) 8–9; Parker, *The Military Revolution. Military* 19–20; Parker, ‘Dynastic’ 154; Parrott ‘Strategy’ (2018) 229–30; M. Roberts, ‘The Military’ 14). Lynn illustrated this brilliantly with the French infantry in 1600–1750 (*Giant* 476). Michael Roberts and many scholars have described the growth of armies in the early modern period (M. Roberts, *Essays* 203–04; Parker, ‘The “Military Revolution,”’ (1976) 206–07; Parker, *The Military Revolution. Military* 24; Lynn, ‘The Pattern’ 3–4, 7; Lynn, *Giant* 55–56, 526–27; Lynn, ‘Recalculating’ 123–25; Lynn, ‘The Trace’ 170; M. Roberts, ‘The Military’ 19–20; Parker, ‘The „Military Revolution”’ (2018) 43–44; Wilson 395; Parrott, *The Business* 74; Mugnai 233; Downing 69; Thompson 91) The transition to linear formations, the increase in width while decreasing the depth of infantry battalions, and the increase in the army’s size should lead to a rise in the width-to-depth ratio of the entire formation. Our research results confirm this phenomenon only partially. We see it only in the Graph for battle formations.

The relationship between the cavalry and the infantry positioning

In the case of all formations in Table 3, we see the most mixed formations with a result of 46.69%, with 34.87% almost classic and only 18.24% classic. The exact order occurs between battle and non-battle formations. The differences between the results in percentages are relatively small. The most significant,

5 SE/KrA/0438/1, k. 67.

6 SE/KrA/0438/5, k. 1-2.

6.22%, occurred between mixed formations among all formations and battles. In battle schemes, we also noted the smallest percentage of classic formations. This means that commanders (52.91%) often tried to mix cavalry and infantry before the battle.

Balcerek's study ('The Battle' 1383) gave very similar results. In first place were mixed formations (47%), in second, almost classical (33%), and in third, classical (20%). The differences between battle and no-battle were minor and amounted to 2-3%.

Tab. 3.

Classical	Almost-classical	Mixed	All
All battle plans			
91	174	233	499
18,24	34,87	46,69	%
Battle			
33	56	100	189
17,46	29,63	52,91	%
Non-battle			
58	118	133	310
18,71	38,06	42,90	%

Tab. 3. Sources: Made by the author

Chart 5.1.1.–5.3.3. Scatter plots showing classical, almost-classical, and mixed patterns for three groups (all battle plans, battle plans, and non-battle plans) over a century (values: 1 – classical, almost-classical, or mixed; 0 – no).

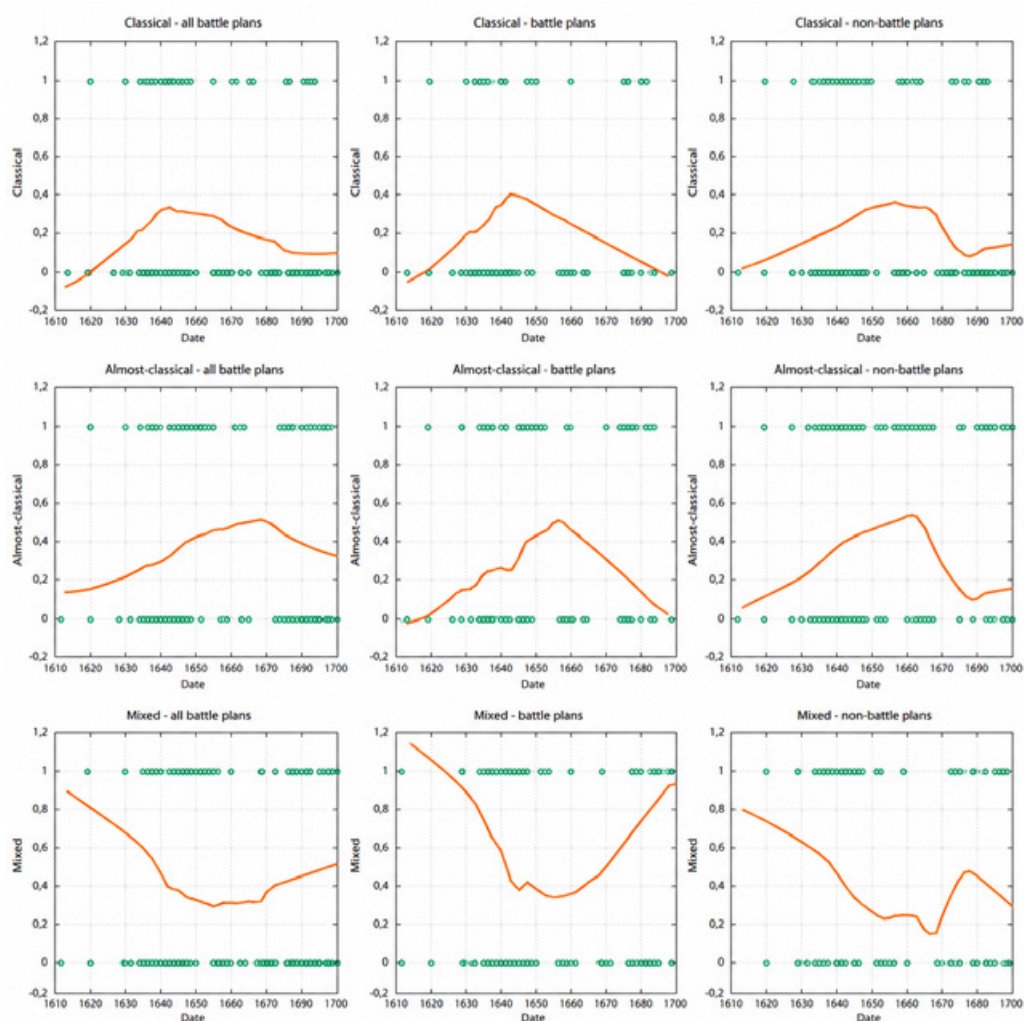


Chart 5. Source: Made by the author

In Charts 5.1.1.–3., we can see the distribution of the occurrence of the classic formation. In the case of all (Graph 5.1.1.), we have noted a clear trend towards the classic formation since the beginning of the 17th century, which reached its peak in 1640. From that moment on, a slow decline began, and from 1656, an apparent decline. From 1680, we have noted stagnation of the line at the level of almost no classic formation. The Graph for battle patterns (5.1.2.) is very similar. Here, the peak falls in the first half of the 1640s, and then we have an apparent

decline until the end of the century. In the case of non-battle formations (5.1.3.), the peak falls in 1656. Later, we had a decline but a short and equally short return towards the classic formation, with a peak in 1673. After that date, the line again heads downwards, reaching a low in 1684, when it slowly begins to go up.

In Graphs 5.2.1.–3., we see the distribution of the occurrence of the almost classical formation. Here, as in the case of the classical patterns, we have noted a clear trend towards the nearly classical formation from the beginning of the 17th century, which peaked in 1675. From that point on, a slow decline began. In the chart for battle patterns (5.2.2.), we also saw an upward trend, but with a temporary break in the 1630s and 1640s and a bottom in 1645. From then on, we had a pronounced upward movement until 1660, after which an equally clear downward trend. The chart for non-battle formations (5.2.3.) is interesting. At first, it looked similar to the all- and battle plans, i.e. first, we had a clear trend towards the almost classical formation with a peak in 1675 and then a decline. In 1686, the trend reversed, which lasted until the end of the century and ended with a peak higher than in 1675.

In Charts 5.3.1.–3., we can see the distribution of the occurrence of the mixed formation. Here, we have noted the opposite distribution of lines from those for the classical and near-classical formations. In the case of all formations (5.3.1.), we have seen a decline in the use of the mixed formation from the beginning of the century, which reached its nadir in 1655. From 1674, there was an increase in this type of scheme. For battle patterns (5.3.2.), the period of the least frequent use of the mixed formation fell in 1642–1660. The Graph for non-battle patterns (5.3.3.) is interesting. Here, too, we declined from the beginning of the century until 1673. Then we noted a substantial increase, but only until the mid-1680s, after which there was a decline.

We only have research results for selected armies. According to Chauviré, during the religious wars in France in the 16th century, the typical pattern was a mixed formation of infantry and cavalry. At the turn of the 16th and 17th centuries, Maurice of Orange, fascinated by antiquity, strove for a classical plan, but we still saw a tendency to place cavalry between the infantry (*The New Knights* 173, 182–83). According to Parker, from the 16th century until the beginning of the Thirty Years' War, infantry and cavalry squares were arranged in a checkerboard, i.e. in a mixed formation (Lynn, 'States' 158). Gustav II Adolf placed most of his

cavalry on the wings but supported it with infantry (Chauviré, *Histoire*; Chauviré, *The New* 191). The described trends can be seen in graphs 5.1.1.–3.3., where we observed a departure from mixed patterns in the first half of the century.

Lynn wrote that the French, during the war with Spain (1635–1659), and also later, arranged the infantry in the centre and the cavalry on the wings, i.e. classically. Additionally, the cavalry was reinforced by infantry placed between the squadrons, i.e. almost classically (*Giant* 532–33). Chauviré used the term classical arrangement for completely and almost classical schemes. According to him, such an arrangement was typical of the times of Louis XIV (1643–1715) (Chauviré, *The New* 208, 224). By the end of the century, according to this researcher, classical arrangements and almost all classics had completely dominated (Chauviré, *The New* 219). We checked that among 16 French formations from the years 1691–1701 in albums with battle formations, the percentage of classical formations was 37.50%, almost classical 56.25%, and mixed only 6.25%. This means that almost completely classical schemes dominated (94.75%). What does it look like for all formations from 1691 to 1701? It turns out that among 108 schemes, mixed schemes prevailed here (53.70%), with 35.19% for almost classical and only 11.11% for classical. The above data are confirmed by the opinions of Artéus and Chauviré, who wrote that during the War of the Spanish Succession (1701–1714), mixed patterns were not uncommon (Artéus 103; Chauviré, *Histoire*; Chauviré, *The New* 225).

Intervals in cavalry and infantry

In Graph 6.1, for all the formations, we have noted a slight predominance of patterns without intervals since the beginning of the century. From the 1640s, the predominance of formations with this element increased. This lasted until 1675. Later, we saw a clear predominance of formations without intervals on the graph.

There are notable differences from the previous graph in Diagram 6.2. During the first two decades of the 17th century, a clear trend emerged to discontinue the use of intervals in the cavalry. In the late 1620s and early 1630s, intervalless patterns dominated. Later, we see a trend towards balancing interval and non-interval arrangements. This continued until 1660 when we see a marked decline in the use of intervals.

In Graph 6.3. for non-battle formations, we noted a different line course than

in the case of 6.1. and 6.2. Here, from the beginning of the century, we tended to use intervals in the formation. In 1630–1682, we noted a predominance of these elements. From 1674, there was a change in the trend direction and a noticeable departure from using this element in the formation, with the intersection of level 0 in 1695.

Chart 6.1.–3. Scatter plots showing the occurrence of intervals in the cavalry of three groups (all battle plans, battle plans, and non-battle plans) over a century (values: 1 – interval; 0 – no interval).

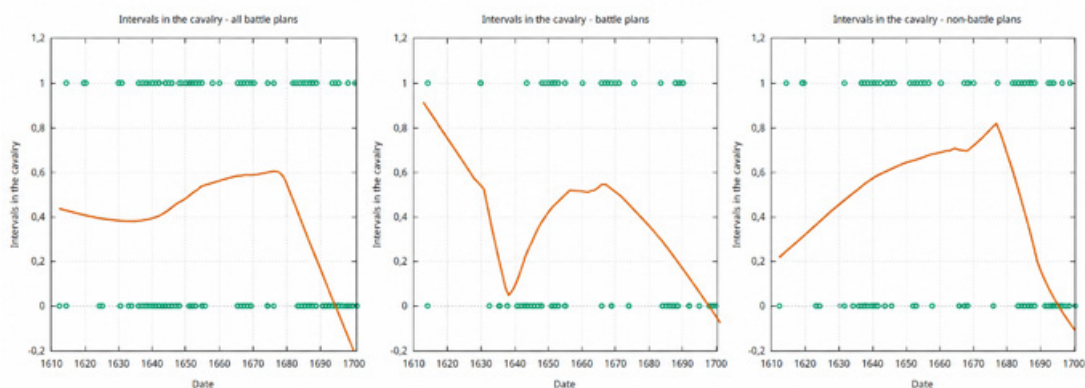


Chart 6. Source: made by the author

Lynn wrote that the French cavalry was drawn up using intervals over the century (*Giant* 533–34). This was confirmed relatively recently by Chauviré (*The New* 200, 211). In Charts 6.1.–3., we have noted a slow departure from them for all formations from 1660 to 1675. Nosworthy dated the drawing up of cavalry without intervals only from the war of Austria with Turkey in the late 17th century (*The Anatomy* 178). The manner in which the creators created the iconography can also explain the lack of intervals. Some of them could mark them, others could not. To this, pseudo-intervals should also be added, i.e., significantly smaller intervals between units, which did not allow intervals.

Artéus researched the occurrence of this phenomenon in the armies taking part in the Great Northern War and the War of the Spanish Succession. Thus, the Swedish cavalry always used intervals, mostly Danish, but the Saxons did not. The French and Imperial cavalry used intervals. Marlborough's famous commander deployed his cavalry without them (34, 45, 64–65, 75–76, 88, 103). Nosworthy wrote that intervals were in the French army until 1753, when the

French implemented “en muraille”, or a unified line, from the Prussians (*The Anatomy* 178–80, 294).

Chart 7.1.–3. Scatter plots showing the occurrence of intervals in the infantry of three groups (all battle plans, only battle, and non-battle plans) over a century (values: 1 – interval; 0 – no interval).

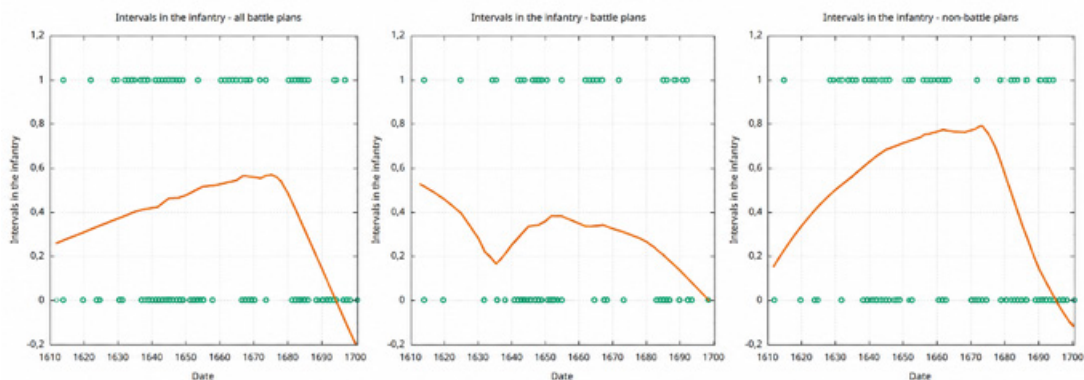


Chart 7. Source: made by the author.

The Graphs for the use of intervals in the infantry resemble those for the cavalry in their general trends. In Chart 7.1., we have seen a tendency towards using intervals since the beginning of the century. The peak was in 1665. From then on, we have seen a slow and precise movement towards non-interval formations from 1675 onwards.

Chart 7.2. showed a tendency towards intervalless formations since the beginning of the century. This continued until 1633 when a change in the opposite direction occurred. This movement stopped in 1645, and from then on, we have noted a tendency to return to intervalless formations.

In the case of the non-battle patterns in Graph 7.3., we saw a clear trend towards interval patterns with a peak at 1675. Then, we had an evident trend away from using such an element.

Rogers wrote that the Swedes used formations based on units arranged in intervals, which was the norm until the end of the 17th century (Rogers 231). French military theorists recommended their use in the second half of the 17th century (Lynn, ‘Tactical’ 181; Lynn, *Giant* 533). According to Lynn and Cathal J. Nolan, intervals in the French army decreased over the century but did not disappear be-

fore 1715 (Lynn, *Giant* 532, 535; Nolan 41). As in the case of cavalry, Nosworthy dated the abandonment of intervals in the infantry to the end of the 17th century and related it to wars with Turkey (*The Anatomy* 23). Graphs 7.1.–3. show that this process started earlier, around 1675.

Artéus noticed that the armies fighting in the War of the Spanish Succession used intervals in the infantry. The situation was different in the Great Northern War. Swedish, Saxon and Russian infantry formations sometimes had intervals between them, and at other times they did not. Only the Danish infantry consistently used them (45–46, 54–65, 75–76, 88, 101). The cessation of forming infantry battalions in lines without intervals dates to the mid-18th century (Artéus 34; Nosworthy, *The Anatomy* 23, 88).

Formations in cavalry and infantry

Charts 8.1.–3. show the use of cavalry formations in ranks. We see such elements only in the first decades of the 17th century. The last instance occurred in 1656. We have not seen a greater number of them since the 1630s.

We have noticed similar results in the relevant diagrams in Balcerek's article ('The Battle' 1384–85). The difference occurs only in the case of trend lines, which do not leave the level without higher units, which is probably the result of a technical error.

Chart 8.1.–3. Scatter plots showing the occurrence of formations in the cavalry of three groups (all battle plans, only battle, and non-battle plans) over a century (values: 1 – formations; 0 – no).

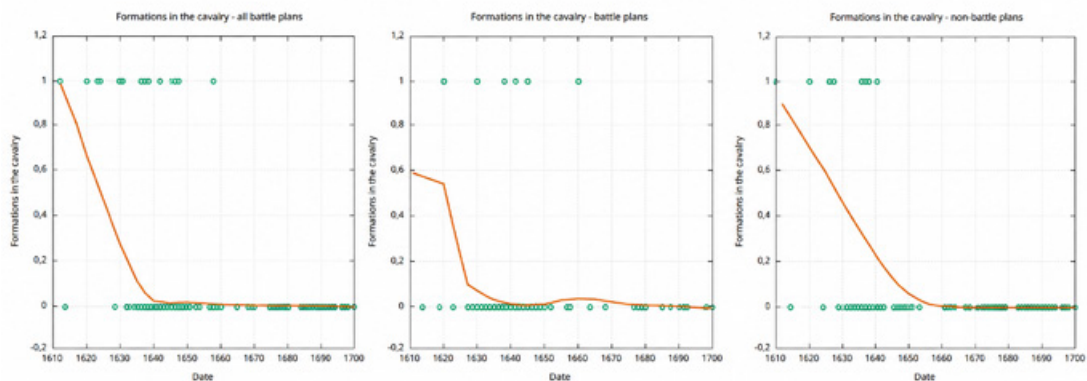


Chart 8. Source: made by the author.

Chart 9.1.–3. Scatter plot showing the occurrence of formations in the infantry of three groups (all battle plans, only battle, and non-battle plans) over a century (values: 1 – formations; 0 – no formations).

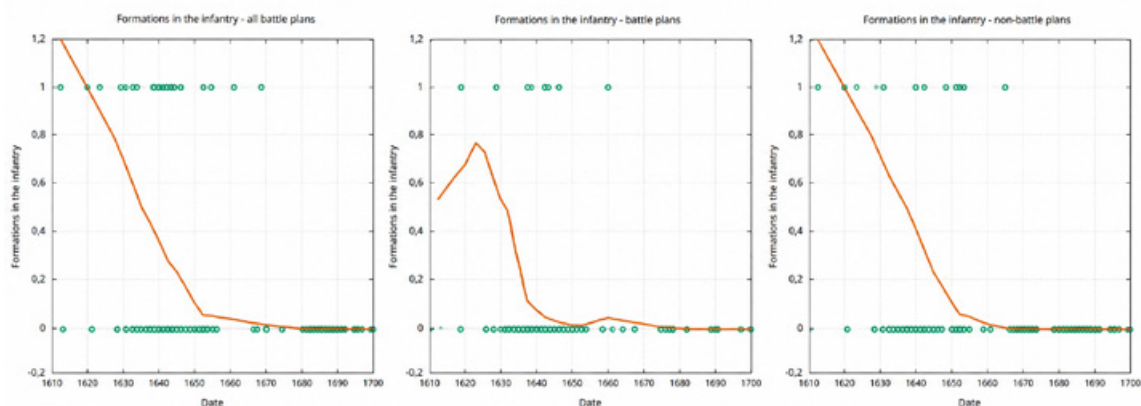


Chart 9. Source: made by the author.

Graphs 9.1.–3. show the use of formations in infantry formations; we saw such elements only in the first half of the 17th century. As a result, in Charts 9.1 and 9.3., we observe a trend line that has been moving towards a level without them since the beginning of the century. The last case was noted in 1656. In the case of battle schemes, we noted a tendency towards the use of formations in infantry at the beginning of the century. This continued until 1624. Then, the trend changed. From the 1650s, we saw only formations without such elements.

The topic of infantry formations in the form of tercios and Dutch and Swedish brigades is well described in the literature (K. Roberts; López; Nosworthy, ‘Dutch’ 6–12; Nosworthy, ‘The Advent’ 10–36). Balcerek described cavalry formations that closely resemble those of infantry (Balcerek, ‘Polskie’ 30–32, 60). We will not find information on the chronological range of the formations in these works. This phenomenon can be linked to the mixed formation, which Parker dated from the 16th century to the beginning of the Thirty Years’ War (‘Dynastic’ 158). This is consistent with what we have seen in Figures 8 and 9.

The formations in cavalry and infantry are a manifestation of the passion for geometrisation on the battlefield, which we described earlier.

Number of units

In Chart 10.1., which shows all the formations, we see a slight tendency for the number of units in a formation to increase at the beginning of the century. This stopped in 1628 at 85, after which the trend line fell. In 1664, the formation averaged 49 units. From the mid-1670s, we see an evident upward trend. In 1700, the average formation was 200 units. We see similar trends in Figures 10.2. and 10.3. In the case of battle formations (10.2.), we see an increase from around 49 to 70 units in 1623 at the beginning of the century. Then we noted a decrease to 50 units in 1636. From the 1640s, we saw a renewed but short-lived increase to 60 units, peaking in 1645. Then we had another decrease to 50 units in 1650 and 49 in 1659. In 1665, the trend line was climbing, to reach 125 units by the end of the century. In the case of graph 10.3. for non-battle patterns, we saw a decrease from 110 units in the plan to 50 in 1675 from the beginning of the century. From then, the trend line began to climb, reaching 230 units in 1700.

Diagrams 10.1.–3. illustrate the large number of units in formations observed during the late 1620s and early 1630s, which reflects the specific representation of the Swedish infantry organised into brigades. In contemporary studies, this formation is often shown as 11 units consisting of pikemen and musketeers (Nosworthy, 'The Advent' 19). A brigade was presented as one unit, two, three, four, up to 42. In the latter case, we have as many as seven pikemen battalions of 216 soldiers and 36 musketeer corporals, each with 24 or 2,376 soldiers. We saw such an arrangement in the drawing showing the parade formation of the Swedish army near Stockholm in 1630. In total, we had 11 brigades or 473 infantry units alone, and 95 cavalry, which gives a total of 568.

On the other hand, we have noted the opposite situation, i.e. units numbering from a thousand to several thousand soldiers. An example is the battle plan of the Catholic army before the battle of White Mountain in 1620, where there were two large cavalry units of Italians and Croats, each numbering 1,000. The opposing side in this clash, the Czechs, had a Hungarian unit in their formation, numbering 6,000 horse riders. The record number was in the unit of janissaries in the formation of the Turkish army before the battle of Vienna in 1683 – 16,000 soldiers, which shows that this did not apply only to cavalry. It is significant that such large units most often appeared in the armies of the Turkish and Habsburg, which usually stood opposite each other.

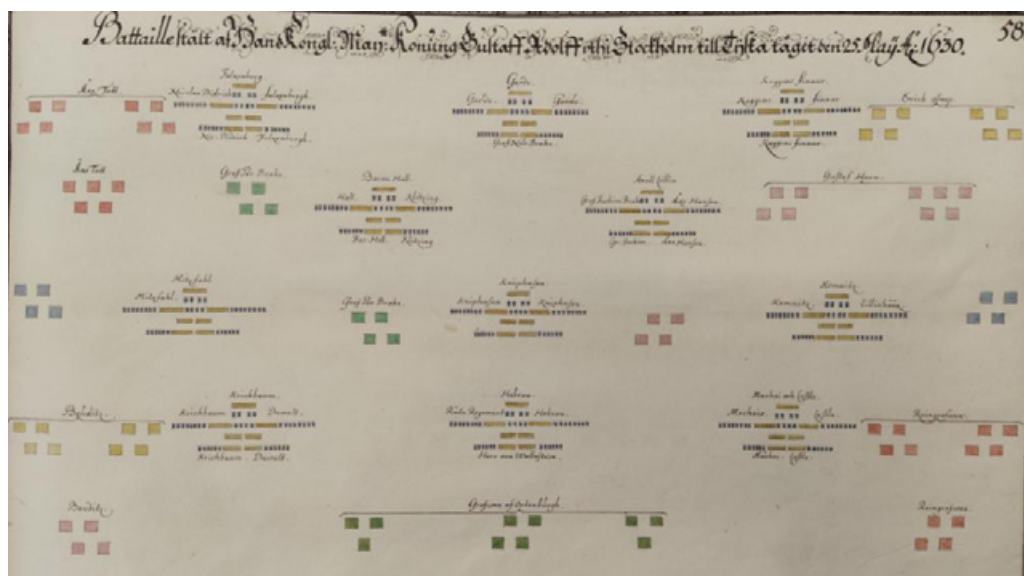


Fig. 4. Battle plan of the Swedish army in Stockholm, SE/KrA/0438/1, fol. 58.

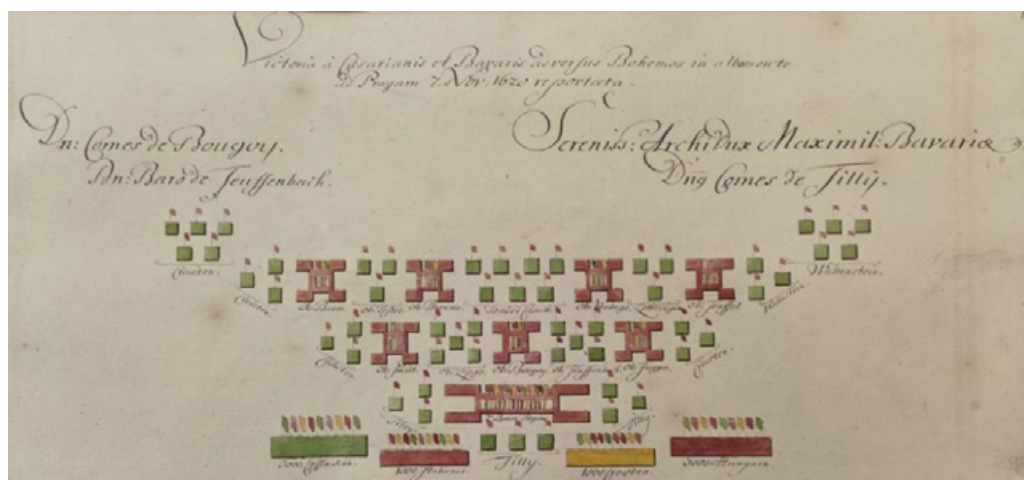


Fig. 5. Battle plan of the Catholic army in the Battle of White Mountain in 1620, SE/KrA/0438/2, fol. 1.

Chart 10.1.–3. Scatter plots showing the number of units (all battle plans, only battle, and non-battle plans) over a century.

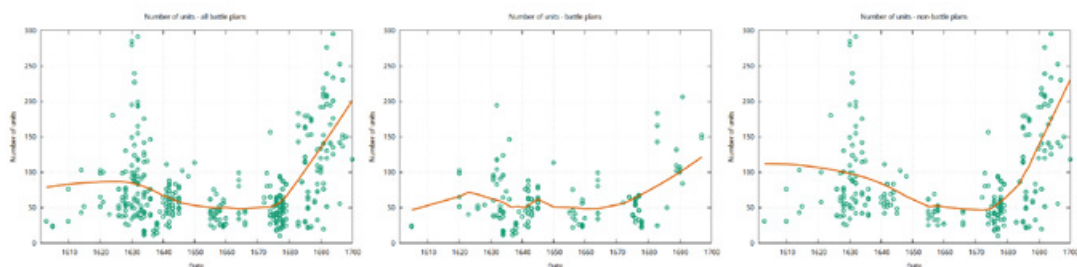


Chart 10. Source: made by the author



Fig. 6. Battle plan of the Turkish army in the Battle of Saint Gotthard in 1664, SE/KrA/0438/5, fol. 45.

Many works were written about developing the army's numbers in the 17th century. This issue is a pillar of the theory of the Military Revolution, which was discussed in the literature. The researchers observed fluctuations in the size of the armed forces over the 17th century, with a tendency to grow (M. Roberts, *Essays* 203–04; M. Roberts, 'The Military' 19–20; Parker, 'The "Military Revolution,"' 206–07; Parker, *The Military Revolution*. Military 24; Parker, 'The „Military Revolution,”' 43–44; Lynn, 'The Pattern' 3–4, 7; Lynn, *Giant* 55–56, 526–27; Lynn, 'Recalculating' 123–25; Lynn, 'The Trace' 170; Frost 308; Wilson 395; Parrott, *The Business* 74; Mugnai 233; Downing 69; Thompson 91). It is worth emphasising and discussing Lynn's article about fortifications and their impact on the French army. The author analysed 135 sieges in the years 1455–1715, and it turned out that in the 16th century, the besieging forces were, on average, 26,000 soldiers and were relatively stable. During the French-Spanish war, 1635–1659, Lynn recorded a decrease to 1700 and then an increase to 41700 in 1672–1697 ('The Trace' 177, 190–94). This is significantly correlated with the results of our

research, which were seen in charts 10.1-3. We also noticed a remarkable similarity in the chart showing France's armed forces' growth in the years 1445–1945 by Lynn ('The Pattern' 7).

The general increase in military forces was accompanied by a decrease in the size of tactical units on the battlefield, which is another pillar of the aforementioned theory (M. Roberts, *Essays* 196; M. Roberts, 'The Military,' 14; Parker, 'The "Military Revolution,"' 198, 201–03; Parker, 'The „Military Revolution,”' 38–39, 41; Bäckström 161). As a result, we should see a steady increase in the number of units in battle formations. In Figures 10.1.–3., we note a constant level of 50–80 units for most of the century (in the case of battle formations, over 60). Only from about 1675 do we see an apparent increase in the number of units in formation, which by 1700 reached the level of 200. This corresponds very closely with the thesis of Black, who dated the Military Revolution to the period from 1660, or more precisely from 1672 (*European Warfare 1660–1815* 95; *European Warfare 1494–1660* 212). It would be worth conducting a future analysis of the number of troops in 17th-century battles. We wonder if the function line would look similar to that in Graphs 10.1.–3.

Conclusions

1. *The symmetry of the battle plans:* The analysis showed that almost 86% of the formations were perfectly or nearly symmetrical. This is strong evidence of the fascination of 17th-century commanders with geometry and harmony. We noticed an apparent decline in perfectly symmetrical formations throughout the century. At the same time, we noted a substantial increase in nearly symmetrical and slightly asymmetrical ones.
2. *Depth of battle order in the form of main throws and lines:* The analysis showed that in the 17th century, armies were most often formed in two main lines (median). At the beginning of the century, troops were formed in 3–4 lines, but from the middle of the century, 2 have dominated. We noticed a similar situation in the case of the analysis of the number of lines, where the average (median) for the entire 17th century was 3. For most of the century, we saw a tendency for the number of lines to decrease, from over 10 at the beginning to 3 in the 70s. Interestingly, their number increased again later, to reach 5 by the end of the century.

3. *The ratio of the width of the order of battle to its depth:* The analysis showed that in the 17th century, the median width-to-depth ratio of the formation was 6:1. For all formations, we noted an upward trend that continued until 1677, after which there was a return to deeper settings. Interestingly, we observed a greater increase in battle and non-battle patterns. A particularly significant increase in the width-to-depth ratio occurred in the case of battle formations.
4. *The relationship between the cavalry and the infantry positioning* The analysis showed that commanders drew up their armies most frequently (46.69%) using the mixed pattern, with 34.87% using the almost-classical pattern and only 18.24% using the classical pattern. The mixed pattern was used frequently in the 1600–1640 and 1680–1700 periods, i.e. for most of the century. The almost classical pattern was used in the 1650–1690 period, and the classical pattern was used most frequently in the 1640–1660 period.
5. *Intervals in cavalry and infantry:* We saw a fluctuating trend in the cavalry over the 17th century towards using intervals for more units. This continued until the 1670s when the cavalry-free schemes began to dominate. In the infantry, we saw a very similar pattern. The curve was also between the two values for most of the century. Ultimately, in the mid-1670s, the infantry-free scheme won out.
6. *Formations in cavalry and infantry:* In cavalry and infantry, we see a decline in the occurrence of taller units over the seventeenth century. This effect occurred more quickly in cavalry than in infantry. In cavalry, we see it until the 1630s; in infantry, it is seen until the 1650s.
7. *Number of units:* For most of the century, we saw fluctuations between the upward and downward trend of 50–100 units. Only from the mid-1670s did we see an apparent increase in the number of units in formation. At the beginning of the century, we had about 80 units; at the end, we had 200. This confirms the theory of the Military Revolution about the growth of units, but only from the 1670s.

The collection of 499 iconographies depicting battle formations provides sufficient material for analysis and drawing far-reaching conclusions. Nonetheless, further research on these patterns is necessary to confirm or refute the above findings.

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