Theory of Reflexive Control

Origins, Evolution and Application in the Framework of Contemporary Russian Military Strategy

Antti Vasara

Theory of Reflexive Control

Origins, Evolution and Application in the Framework of Contemporary Russian Military Strategy

Antti Vasara

ABSTRACT

The purpose of this study is to establish what is meant by reflexive control, how it can be applied, and the methods that can be used to apply it. The study combines reflexive control with the broader concept of systems theory, and the author also examines issues from perspectives that are rarely discussed in Western source material. At the same time, by making extensive use of publicly available Russian and Western documents, the author also attempts to lessen the aura of secrecy around the topic, which often characterises the debate in the West and which may well be unfounded.

To understand what lies behind reflexive control, the author discusses the interface between cybernetics and systems theory. The study focuses on reflexive systems, one manifestation of these concepts, in which the system attempts to adjust its operations in accordance with a similar system used by the adversary. In other words, it attempts to *reflect* the other side's system in its own activities.

The study goes through the development of the concept during the Soviet era and concludes with the developments in the field in Russia after the collapse of the Soviet Union. Having reviewed the history of reflexive control, the author discusses its concepts and application in connection with the debate in Russia on the nature of warfare and influencing military decision-making. A comprehensive model of reflexive control is presented in the study using these principles.

At the end of the study, the author places the findings made in this research in a broader context. The conclusions lend credibility to the assumption that Russia is using an analysis of the adversary's command and control systems at all operational levels. It is thus highly improbable that the activities are based on pure opportunism. Instead, as this study suggests, Russia's attempt to conceal the higher-level strategy is a more likely explanation.

In his conclusions, the author also suggests that the assumption in the Russian approach to information operations (which arises from an objective world view) is that when specific information is fed through a specific information channel, the response can be anticipated. This differs from Western thinking. The difference may also explain some of the challenges faced by Western researchers in studying Russian information operations.

Keywords: Command and Control, Cybernetics, Decision-making, Information Warfare, Reflexive Control, Reflexivity, Russia, Soviet Union, Systems, Systems Theory

PREFACE

The Russian theory of reflexive control (here after RC) has intrigued Western researchers for decades. One of the first and most complete descriptions of the theory was written by Diane Chotikul in 1986 for the US's Naval Postgraduate School. Now, Antti Vasara, a Finnish analyst, has produced the first truly comprehensive update of RC in recent years.

Vasara assembled over 100 documents on the topic and close to half were Russian publications. [Full Disclosure: this author was one of his sources] His primary research begins with the work of Vladimir Lefebvre, who most believe is the originator of the theory of reflexive control. It was Lefebvre's 1984 work "Reflexive Control: The Soviet Concept of Influencing an Adversary's Decision-Making Process" that gained him the most notoriety. Vasara scanned the journals *Voennaya Mysl' (Military Thought)*, *Armeysky Sbornik (Army Journal)*, and *Morskoy Sbornik (Naval Journal)* to uncover a host of articles on the topic that support and update his work well beyond Lefebvre's work.

Vasara begins the discussion from the point where the RC concept originated, in the works of Soviet theoreticians studying cybernetics, decision-making, and systems and control theory. That discussion is followed with a look at Russian command and control systems. In one 2007 *Military Thought* article that he summarized, it was noted that a system can make decisions and organize its activities by taking into account the decisions of another complex system interacting with it, where reflexion is understood as the reflexion of the adversary's analytical decision-making process. This can cause a system to make decisions advantageous to one's own, which is the basis of thought behind RC.

Based on Vasara's understanding of these and other theoretical constructs, he prepared his own system-theoretical and cybernetic model of the Russian approach to command and control. It is composed of human decision-makers; the decision support system supporting a staff; the command system with its information relay and feedback channels; and the system subordinated to the commander and the corresponding system of the enemy. Several diagrams support this contention. Influence operations, he added, are aimed at the commander first and at his staff second, as they are the main decision-makers of an opponent.

The model is divided into a constructive (creative) method and a destructive method. The former employs procedures aimed at inducing the enemy to make desired decision, while the latter employs methods that attempt to weaken and disrupt the enemy's decision-making. The model features different types of RC, different forms of control inputs, and different methods for exerting RC. Constructive inputs are based on the action of one's own troops and the information, and psychological inputs are based on the starting point or the situational picture created for the enemy's decision-makers advantageous to one's own side. Destructive inputs include the use of surprise/deception by one's own troops or the feeding of information to the enemy's system and decision-makers to create confusion. In Vasara's words, the model "encompasses all aspects of RC, from the methods of exercising it to its goals, using the division Ends-Ways-Means produced for Arthur Lykke's military strategy article in 1989."

The core of RC, in Vasara's opinion, is as follows (which is stated a bit late in the paper):

> Vladimir Lefebvre, the man behind the RC theory, attempted to develop reflexive equations to model the adversary's decision-making process that could be used to calculate the options available to the adversary. This creates a situation where the other party to the conflict can gain an advantage if it knows the adversary's situational picture and is aware how the adversary applies it to its own doctrine to solving the problem.

Russian has long had an interest in an adversary's decision support systems. The Kremlin's security specialists appear to analyse an adversary's command and control system at all levels. Thus, RC's impact at the strategic level cannot not be ignored, Vasara notes, as it can be a systemic approach for use as a negotiating tool and, based on its Soviet upbringing, it will probably not disappear when power changes hands.

Vasara also noted that in the past decade there has been a shift in Russian reflexive equations towards RC over an adversary in practical combat operations, as analysed particularly in the work of Kazakov, Kiryushin, and Lazukin, which discussed the use of so-called information packets on the battlefield. Vasara noted that in Russia's case "conveying one's own narrative and views through a large number of different channels and hoping that they are seized by at least some Western media is the goal," making something available to use to back up its case. The main aim is to create several alternative truths.

Vasara's paper is unique for its attempt to decipher the Russian approach to RC and offer Western audiences another way to understand it based on the model he proposed. His division of the topic into constructive and destructive measures is relevant to ascertaining the goal of Russia's RC methodology.

Finally, for the reader who thinks there are gaps in Vasara's research, he explains why he chose specific language to describe RC and his model as he did, as well as what he saw as potential gaps in his research and conclusions. In short, he has offered analysts not only a creative approach to RC that others can study and use but also areas in which to study the concept further. Western institutes devoted to studying Russian deception techniques should put this paper on their required reading list.

Timothy Thomas

US Army, retired

CONTENTS

List of figures:

List of tables:

List of appendices:

1. INTRODUCTION

1.1 Background to the research

The ability to make decisions is one of the prerequisites for effective leadership. In a situation where the number of decision-makers is limited, exerting direct influence on them is an effective way of making policy and waging war. The changes in the information environment and the blurring of the distinction between war and peace over the last few decades have increased the number of potential decision-makers and targets for influence operations. At the same time, efforts to influence decision-making are now being studied more comprehensively, both in the West and in Russia. The influence operations directly or indirectly carried out by Russia in the information environment have been studied from a wide range of different perspectives in recent years. The focus in this study is on reflexive control, one of the theories behind these operations. The reflexive control applied by the Soviet Union was already attracting interest in the West in the 1980s. However, with few exceptions, most researchers have ignored the cybernetic and system-theoretical aspect behind its use.

In the Western research tradition, decision-making has been seen as particularly rational behaviour, as observed in game theory models or Economic Man thinking (Mill, 1836), or it has been examined against the background of limited rationality, as first discussed by Herbert Simon (Simon, 1955). The problem of limited rationality is also discussed by Kahneman (2003), who describes the dissonance that prevents us from making fully rational and objective decisions. Thus, in Western research on decision-making, consideration is given to the subjective nature of decision-makers as part of the decision-making process.

Likewise, since the late 1970s, decision-making by military organisations and military leaders has been described as a time-pressured process, and the well-known O-O-D-A loop, developed by John R. Boyd in the United States, is an example of this (Boyd, 1996). In this model, making decisions more quickly than the adversary is described as the crucial element in the battlefield. After Boyd, decision-making in hierarchical organisations has been studied by researchers such as Klein. In his view, individuals in fast-moving, time-pressured situations usually base their decisions on previous experiences, prioritising solutions which in their view work best, instead of rationally considering different options (Klein, 2008).

In the Russian context, debate on military leadership is not based on the above models, but stems from the understanding of dialectic and systemic nature of command and control process. This tradition did not disappear with the breakup of the Soviet

---

[1] Antti Vasara (b. 1977) Major (General Staff), works at the Infantry School (Army Academy) as the chief of Officer Education Department.

Union, when dialectical materialism lost its status as the official ideology. It is still widely used as a research philosophy in military leadership and in studies of the subject (Lalu, 2014, p. 368).

A widely held view among scholars is that reflexive control is only used in information warfare and perception management. In this study, reflexive control is interpreted as a comprehensive approach and an umbrella concept, and to gain a better understanding of the method, it was necessary to establish how the concept of warfare was viewed in Russia. This study therefore provides an overview of the basics of military cybernetics and systems theory, and the author also delves into Russian thinking, decision-making and systems theory.

To understand what lies behind reflexive control, the author discusses the interface between cybernetics and systems theory (cybernetic systems where the system is guided by the feedback on the way in which it functions). The study focuses on reflexive systems, one manifestation of these concepts, in which the system attempts to adjust its operations in accordance with a similar system used by the adversary. In other words, it attempts to *reflect* the other side's system in its own activities. The author first discusses the 1960s writings of Vladimir Alexandrovich Lefebvre (b. 1936), who developed the original theory, and who later moved to the United States, and then discusses the theoretical and practical applications of the concept in the Soviet Union in the 1980s. The discussion concludes with an overview of developments in the field in Russia after the collapse of the Soviet Union. The development of the reflexive control theory has continued in Russia during recent years, and it is based on the assumption that human decision-making can be objectively modelled. Having reviewed the history of reflexive control, the author discusses its concepts and application in connection with the debate in Russia on the nature of warfare and influencing military decision-making.

According to Timothy Thomas, a senior US military analyst who has studied reflexive control, the measures applied in the Ukrainian conflict match the descriptions of reflexive control published in Russian military journals in the early 2010s. In his view, NATO's strengthening of its forces on its border with Russia was precisely what Russia aimed to achieve when taking reflexive control measures (Thomas, 2015, p. 117). Thomas adds that the reflexive variations described by Valery Makhnin, a Russian military researcher, in 2012 are in line with the way in which the events at Maidan Square in Kiev were described in the Russian media, and that Russia might attempt to introduce the two-level control on its border with Ukraine described by Vladimir Kazakov and Andrei Kiryushin in their article in the journal 'Voennaya Mysl' in 2014 (ibid., p. 118). The topic has also been discussed by Can Kasapoglu, a researcher at the NATO Defense College, who suggests the use of reflexive control by Russia might cause an 'analytical paralysis' in the West. As a result, the West might opt for measures perceived as less risk-prone, which would actually help Russia to achieve its objectives through force (Kasapoglu, 2015, p. 12).

The topic has also been discussed in Russia in recent years. Colonel General Sergei Surovikin, Commander-in-Chief of the Russian Aerospace Forces, has written that the aim of the Russian armed forces should be to achieve information superiority and the disorganisation and weakening of decision-making in the adversary's government

and military structures (Surovikin & Kuleshov, 2017, p. 7). Both are also the goals of reflexive control. Indeed, according to the findings of this study, theoretical development discussed in articles and practical action have progressed side-by-side.

The dual reflexive model created for this study is described to enable future researchers to use it when trying to understand how Russia sees reflexive control as an element in the overall process of influencing decision-making, and how it attempts to influence decision-makers.

In the conclusions presented at the end of the study, the author places the findings made in this research in a broader context. The conclusions lend credibility to the assumption that Russia is using an analysis of the adversary's command and control systems at all operational levels. It is thus highly improbable that the activities are based on pure opportunism. Instead, as this study suggests, Russia's attempt to conceal the higher-level strategy is a more likely explanation.

In his conclusions, the author also suggests that the assumption in the Russian approach to information operations (which arises from an objective world view) is that when specific information is fed through a specific information channel, the response can be anticipated: in the final analysis, individuals' subjective opinions about the information are irrelevant. This differs from Western thinking. The difference may also explain some of the challenges faced by Western researchers in studying Russian information operations.

1.2 Structure of the report

The report starts with an overview of the development of systems theory and cybernetics in the Soviet Union and Russia from the 1950s to the present, describes different command and control systems, and discusses the leadership principles applied in the Russian armed forces. This is used as a basis for a reflexive model of military decision-making. The aim is to show how cybernetic principles have shaped Russian military command practices, and how they may have been a factor behind the creation of reflexive control.

In the main part of the report, the author describes the development that has continued side-by-side with cybernetic research since the 1960s, and that has shaped Soviet and Russian thinking on how to influence an adversary's decision-making and decision-makers. The theory of reflexive control has emerged from these developments. The aim is to provide a detailed overview of the history and development of reflexive control and to broaden the understanding of the role played by reflexive control in influence operations.

The theoretical part is followed by the presentation of a reflexive control model. The dual model, prepared in conjunction with this study, provides a broader approach to influence-exertion methods than the reflexive control models described in existing studies, and it is divided into constructive and destructive reflexive control methods.

In the conclusions presented at the end of the report, the author analyses how systems theory and reflexivity have influenced the fundamentals of Russian strategic thinking,

and assesses the differences between Russian and Western ways of influencing decision-making. The author also reviews the usability of the reflexive control model created in the report for future research and lists some of the topics for additional research arising from this study.

1.3 Existing literature on systems thinking and reflexive control theory

In recent decades, systems theory, cybernetics, and reflexive control have been extensively studied around the world, but few researchers have drawn attention to the parallels between them. In addition to the research carried out in the West, the topic has also been extensively studied and discussed in the Soviet Union and Russia, and these research and publication activities are reviewed at the end of this chapter.

The study written by Diane Chotikul, who has worked at the US Naval Postgraduate School, provides the most detailed source of information on the relationship between systems theory, cybernetics, and reflexive control for this document. Her work 'Soviet Theory of Reflexive Control in Historical and Psychocultural Perspective: A Preliminary Study' (Chotikul, 1986) has served as a basis for the positioning of this document and prompted the author to examine these three concepts as complementary and parallel functions. Chotikul's study is also important, because it provides a detailed analysis of the cultural differences between the Soviet Union and the West. Understanding of cultural differences also helps to understand the fundamentals of reflexive control.

The article 'Reflexive Control in Soviet Military Planning' (Reid, 1987) by Clifford Reid, who has also worked at the US Naval Postgraduate School, has served as the second cornerstone of this study. The article is contained in the publication 'Soviet Strategic Deception' (ed. Dailey & Parker, 1987). In his article, Reid describes the birth and development of reflexive control. Reid uses articles and literature published in the Soviet Union as a basis for a comprehensive description of reflexive control methods.

Timothy Thomas, who has worked as a researcher at the Foreign Military Studies Office of the US Army, is the most frequently quoted researcher into reflexive control in the West. He has studied the Russian approach to warfare, Russian thinking, and reflexive control since the mid-1990s. Thomas's research has also been noted in Russia, and his texts are often quoted in Russian military journals. In his article 'Reflexive Control in Russia: Theory and Military Applications' (Thomas, 2002), published in the journal 'Reflexive Processes and Control', Thomas divides the development of reflexive control between the 1960s and the 2000s into four distinct phases, and this division is also used in this study.

In addition to these articles, the book 'Recasting the Red Star' (Thomas, 2011), discussing the development of Russian military power and reflexive control in the early 2010s, and 'Russia Military Strategy – Impacting 21st Century Reform and Geopolitics' (Thomas, 2015), which complements the former work and discusses the possible use of reflexive control in Ukraine from a variety of different perspectives, have also been used as sources in this study. Thomas's work 'Thinking Like a Russian Officer: Basic Factors and Contemporary Thinking on the Nature of War' (Thomas, 2016)

has also been used in the sections of this study discussing Russian military command practices and decision-making. The latest works by Thomas, 'Kremlin Kontrol' (Thomas, 2017) and 'Russian Military Thought: Concepts and Elements' (Thomas, 2019) were used by the author in reviewing the most recent developments. The articles and the other literature from the 2010s used in them also served as sources for this study.

In his doctoral dissertation 'The Origins and Development of Systems Thinking in the Soviet Union' (Susiluoto, 1982), Ilmari Susiluoto studied the creation and development of systems theory in the Soviet Union to determine the link between the planned economy and systems thinking. In his dissertation, Susiluoto concludes that the Soviet aim was to exert scientific control over society using a combination of cybernetics and systems theory. Similar conclusions have been presented by Slava Gerovitch, a researcher at MIT. In his work 'From Newspeak to Cyberspeak – a History of Soviet Cybernetics' (Gerovitch, 2002), he describes the development of systems theory and cybernetics in the Soviet Union from the 1950s to the 1980s. The findings of Gerovitch and Susiluoto are also supported by the conclusions made by Benjamin Peters in 'How Not to Network a Nation' (Peters, 2016). In his book, Peters, a researcher at MIT, discusses the Soviet attempts to create a nationwide information network. The development of cybernetics is closely connected with these efforts.

'Venäjän informaatio-psykologinen sodankäyntitapa terrorismin torjunnassa ja viiden päivän sodassa' (Russia's Information-Psychological Warfare in Counter-Terrorism Operations and the Five-Day War) (Berger, 2010), written by Heidi Berger, was also used as a source. In her book, Berger presents key definitions of reflexive control and discusses its operational use. Her conclusion is that Russia uses reflexive control in its domestic and foreign policy, and at all levels of warfare (Berger, 2010, p. 145). Unlike Berger, the author has attempted to model reflexive control more extensively as part of the strategic psychological-social deception used by Russia and the confrontation between societies.

'Warfare in Hybrid Environment – Reflexive Control as an Analytical Tool for Understanding Contemporary Challenges' (Huhtinen, Kotilainen, Streng, & Särmä, 2018) is one of the most recent articles discussing reflexive control. The authors conclude that reflexive control is a broader concept than information warfare, and understanding it also helps to analyse the multidimensional concept of hybrid warfare (Huhtinen et al., 2018, pp. 72–73). Another purpose of this study is to increase the understanding of reflexive control as a concept that entails more than merely information warfare.

Russian information operations and reflexive control have also been studied at the Finnish Institute of International Affairs. In the second part of its report 'Fog of Falsehood – Russian Strategy of Deception and the Conflict in Ukraine' (Pynnöniemi, 2016), reflexive control is characterised as a component in the Russian approach to strategic deception. Katri Pynnöniemi, the report's author, notes that reflexive control is one way of achieving the enemy's self-disorganisation. According to Pynnöniemi, the enemy can be targeted with specially selected pieces of information capable of causing changes in its information processes or information systems in accordance

with the intention of the entity using the weapon (Pynnöniemi, 2016, pp. 36–37). Similar conclusions are reached in this study, although it draws on a broader range of research material.

An article discussing the application of reflexive control principles in information and cyber operations has been published in the 'Journal of Information Warfare' (Jaitner & Kantola, 2016). One of the authors' conclusions is that reflexive control is a result of a long-term process and provides only one perspective on theories about information warfare. One aim of this study is to broaden the perspective beyond information warfare.

'Russian Reflexive Control' (Giles, Seaboyer, & Sherr, 2018) is an example of the more recent studies of reflexive control. It was written by Keir Giles and James Sherr, both researchers at Chatham House, and Anthony Seaboyer, a teacher of political history at the Royal Military College of Canada. In line with this author's conclusions, these researchers also highlight the long-term and systematic nature of reflexive control.

In addition to the above-mentioned publications, reflexive control has also been studied in Sweden (Furustig, 1994; Värnqvist, 2016), in the United Kingdom (Blandy, 2009), in Latvia (Berzinš, 2014) and in NATO (Kasapoglu, 2015). While using these publications in this study, attempt has also been made to identify gaps in existing research and the author has questioned some of their assumptions.

From the perspective of combining theory and practice, it should be noted that in Western research, reflexive control has been interpreted as a factor explaining past and present Russian activities in Chechnya (Berger, 2010), in Georgia (Berger, 2010; Blandy, 2009; Thomas, 2011; Värnqvist, 2016; Giles, Seaboyer & Sherr, 2018), on the Crimea (Kasapoglu, 2015; Giles, Seaboyer & Sherr, 2018), in eastern Ukraine (Berzinš, 2014; Giles, Seaboyer & Sherr 2018; Thomas, 2015) and in Syria (Giles, Seaboyer & Sherr, 2018). Prompted by these findings, the author decided to use the empirical material in accordance with the dual model prepared in the study.

Of the Western studies discussing the Russian strategic culture and examining the topic from the perspective of a confrontation between systems, the author has used the article 'The Culture of Strategic Thought Behind Russia's Modern Approach to Warfare' (Covington, 2016) by Stephen R. Covington. In his article, Covington, a veteran expert on Russia, describes the comprehensive Russian approach to warfare from a Western perspective. This perspective is complemented by the article 'Russia's quiet military revolution and what it means for Europe' (Gressel, 2015) written by Gustav Gressel, an Austrian security expert and a researcher at the Council of Europe. The study 'The Russian Way of War' (Bartles & Grau, 2016), written by Lester W. Grau and Charles K. Bartles, two veteran researchers at FMSO, has been used as a source in matters concerning military command and control issues.

1.4 Primary research material

The primary research material used by the author comprises Russian research literature on cybernetics, systems theory, command and control, decision-making and the theory of reflexive control. Field manuals and studies of military science subjects published in the Soviet Union and used by the author are from the *Russica* collection of the Finnish National Defence University library.

The study written by Vladimir Lefebvre, the man behind the original theory of reflexive control, and the researchers associated with him, served as the key source of information on reflexive control. The following works by Lefebvre were used in this study: 'Konfliktujustshie struktury' (Lefebvre, 1967), 'Algebra of Conscience' (Lefebvre, 1984a) and 'Reflexive Control: The Soviet Concept of Influencing on Adversary's Decision-Making Process' (Lefebvre, 1984b). The author also used articles that Lefebvre has published in English during the past two decades and the work 'Lectures on the Reflexive Games Theory' (Lefebvre, 2010). Other Soviet and Russian sources used by the author include the work 'Voprosi voennoi sistemotehniki' (Druzhinin & Kontorov, 1976) by Druzhinin and Kontorov and the articles by Dimitri Novikov published over the past twenty years.

The electronically archived articles published in Russian military journals since the late 1990s were accessed through the East View search service. The military theoretical journal 'Voennaya Mysl' published by the Russian Ministry of Defence (and its Soviet predecessor) and its English version 'Military Thought', the journal 'Armeiskij Sbornik' of the General Staff of the Russian Armed Forces and the journal 'Morskoi Sbornik' of the Russian Navy were the key Russian journals used as sources. A small number of articles published in other military journals were also used.

The assumption at the start of the work was that the secret nature of the topic would make it difficult to obtain source material on theoretical aspects of reflexive control. However, this assumption proved unfounded as the work progressed: there was enough material from both Western and Russian sources. The hierarchy of the theoretical source material was the main problem concerning its use: it became clear that there is no 'official' truth of reflexive control and as a result, the author decided to use the original writings of Lefebvre as the basis for his interpretations and as references for subsequent texts. It also emerged that a small number of key articles, such as 'Russia's Reflexive Control Theory and the Military' (originally Thomas, 2002), published by Timothy Thomas in 2004 had been used as sources by both Western and Russian writers and in some of the articles, only a small number of sources were listed. In fact, it soon became clear that there were few texts with genuine added value and it may also be that too much prominence has been given to such writers as Chausov or Makhnin. The absence of articles taking a critical view on reflexive control was a problem: the author was only able to find one article (Polenin, 2000) discussing the topic from this perspective.

1.5 Notes on key concepts and translation

Before discussing the theoretical insights of previous research, a few observations on translation of key concepts is necessary. Of the Russian words used in this text, the word 'upravlenie' (управление) ('control') and its derivatives, such as 'refleksivnoje upravlenie' and 'upravlenie voiskami', are the ones with the largest number of meanings (and translations).

There is no corresponding word in the English sources, so attempts have been made to understand the language used by the Russian military. Thus, depending on the context, the word 'управление' has been translated as 'control', 'management' or 'command and control' and differences between them have been created artificially in the original Russian texts.

The author has followed the practice observed by Hall (Hall, 1991) when using English-language source material. In Hall's view, the Soviet (Russian) approach to command and leadership differs from Western thinking. The Russian expression 'upravlenie voiskami' is usually translated as 'command and control' (C2). However, literally it means 'management of troops', and thus it can also refer to other actions directed at military forces. These are not limited to warfare and successful operations as in Russian thinking, they also involve the maintenance of a high level of combat readiness and preparing for combat missions. Raising morale, training and administration, and organising the troops are all part of the 'management of troops'. In the Russian view, the end result of the battle depends to a great deal on the effectiveness of these actions taken before the combat. For this reason, 'upravlenie voiskami' cannot be directly translated as 'command of troops' (Hall, 1991, p. 132).

However, 'management of troops' is not the correct translation for the Russian term either. This translation fails to convey the fact that the Russian term refers to a successive management process and not merely to the direct action of commanding troops. 'Giving orders' (командование) is an instrument implementing the directing function, whereas 'management' (управление) implements the action itself. The fact that the Russian translation for 'reflexive control' is 'refleksivnoje upravlenie' ('reflexive management') and not 'kontrol' is also relevant to this study. Management is a dynamic process, which includes both inputs and feedback. In Russian, the word 'control' (контроль) is used to describe feedback functions and supervision. Thus, directing and execution are seen as two separate though continuous and mutually dependent (dialectical) functions (Hall, 1991, p. 132-133).

When we descend to lower levels of command, the difference between these two functions gradually disappears. In the view of Ivanov, Savelyev and Shemansky, the authors of a Soviet book on commanding troops published in 1977, the decision-making process is also the basis for the management of troops. At the same time, 'command' and 'administration' become a single concept and 'directing' is a rough equivalent to 'leadership'. In fact, 'command and management of troops' could be a better translation for 'upravlenije voiskami' (Hall, 1991, pp. 132–133), while at the same time, 'refleksivnoje upravlenie' could be translated as 'reflexive management' instead of 'reflexive control'. However, the author has decided to adhere to the term

'reflexive control' used by other researchers to ensure that this study can be related to their work.

As a rule, non-military applications of cybernetics, systems theory and reflexive control are outside the scope of this study. This rule is not absolute because in the Soviet Union, there was no separation between military and civilian research. In cybernetics, the author focuses on Soviet and Russian branches of cybernetics, while in military command and control, only the way in which it relates to systems theory and reflexive systems is discussed. Non-military applications of reflexive control are not discussed in this study even though since the early years of 2000s, it has been possible to apply reflexive control to nearly all branches of science in Russia (cf. Lefebvre, 2002; Novikov, 2015; Semenov, 2017).

2. THEORETICAL ORIGINS AND EVOLUTION OF REFLEXIVE CONTROL

2.1 The importance of systems theory in Soviet and Russian military research

According to Sergey Bogdanov and Sergey Chekinov, two authoritative Russian military researchers, systems modelling and systems theory are instruments for producing effective ways of warfare that suit each particular situation and doctrine (Bogdanov & Chekinov, 2015, pp. 99–100). In their view, studying systems is essential in the efforts to solve problems of military theory and practice, and they note that system research may accelerate the adoption of new approaches to military science and make it easier to tackle its dialectical challenges.

According to the definition presented by Bogdanov and Chekinov, research on military systems is a theory of systems intended for military purposes (ibid., p. 102), and they conclude that all problems at military level can be solved by constructing a specific system for each of them. Problems can be identified by applying the strategy created for this system, while operational skills help to solve the problems and tactics produce the tasks for the system parts (ibid., p. 108, pp. 109–111). In this chapter, the author discusses how the hypothetical structure described above has been built and what types of systems for command and control were developed in the Soviet Union and have been developed in Russia.

2.1.1 Soviet approach to cybernetics

In contrast to the general Russian academic tradition, the cybernetic movement in the Soviet Union tried to instil preciseness and uniformity in Soviet science (Gerovitch, 2002, p. 1). In the West, cybernetics remained a concept that was of interest to a relatively small circle of researchers, whereas in the Soviet Union, cybernetics became part of the scientific mainstream in the 1960s, and it was used as an ideological language (ibid., pp. 2–3). In this chapter this process is described and the author attempts to place the theories of reflexive control and decision-making appropriately in the Soviet timeline of cybernetics and systems theory. This has been prompted by the willingness to understand current Russian models of decision-making and influencing decision-making.

The topic is approached from the Soviet perspective, in which it was important to view the subjects on a holistic (systemic) basis. In this approach, all phenomena were examined on the basis of dialectical laws, in which the identified material phenomena constitute the real world, which is reflected in human thinking. As the existence of this universal connection was recognised by Soviet scientists, it was easy for them to approach planning and control on a 'systemic' basis. Unlike in the Western tradition, where problems are broken down, and each of them is examined separately, in Russia, the system is examined as a whole, and the aim is to identify all components that have a direct or indirect impact on the sector under examination. To Western eyes, this often seems complicated but in Soviet science, systemic approach meant identifying

and examining objects (processes and phenomena) as a dialectical system of interactive elements. Systemic approach is a concrete manifestation of Marxist dialectics, in which all world phenomena are interconnected (Chotikul, 1986, pp. 29–30).

As early as 1912, Alexander Bogdanov, a Russian philosopher, developed the idea of tectology, a universal discipline of organisations. According to Bogdanov, all animals, machines, humans, thoughts and societies are 'organised systems', which are only distinguished by their level of complexity. In his dissertation, Susiluoto compares Bogdanov's thinking with the thoughts presented by von Bertalanffy, considered as the father of the general systems theory, in the 1960s and finds that there are clear similarities between the two (Susiluoto, 2006, pp. 70–71). To Bogdanov's misfortune, his thoughts were first denounced by Lenin in 1910 as incompatible with dialectics (Susiluoto, 1982, pp. 122–123), and when he tried to present his theories again, he incurred the wrath of Stalin, Lenin's successor, who quickly branded Bogdanov's thinking as dangerous (ibid., pp. 124–126, 129–132). During Stalin's purges, tectology and Bogdanov were linked to the thoughts of Bukharin, declared as an ideological traitor, and as a result, systems theory remained a banned topic until the end of Stalin's rule (ibid., pp. 136–140).

In 1929, Nikolai Bernstein, a Soviet neurophysiologist, wrote for the first time that when acting in a goal-oriented manner, human brain creates two models: the real world (the model describing what exists around us) and the goal (the model of what will exist around us in the future). Bernstein called the function linking these two models as the feedback arising from the joint impact of neurons and muscles. In 1934, he proposed that the concept 'reflex arc', according to which the stimulus-reaction link moves in a single direction should be replaced with the concept 'reflex circle', in which the stimulus and reaction also move in the opposite direction (Gerovitch, 2002, p. 109). Identical results were published by Norbert Wiener, one of the founders of cybernetics, 15 years later (Susiluoto, 2006, p. 99). However, Bernstein's theories were not appreciated as they ran counter to the Pavlovian physiology, and in the Soviet Union, he was marginalised (Gerovitch, 2002, p. 109).

In the West, Norbert Wiener, a US mathematician working at MIT, published the work 'Cybernetics, or Control and Communication in the Animal and the Machine' in 1948. The book, which has become the classic work of cybernetics, is based on Wiener's research and the ideas that arouse from his discussions with Arturo Rosenblueth. In the introduction to the book, Wiener states that cybernetics is a composition of the control and communication theory (Wiener, 1961, pp. 12–14) and illustrates this with his own experiences in the design of anti-aircraft human-machine systems (Peters, 2016, p. 17). Wiener presents in his book a number of key concepts, such as the role of anticipation in the next phase of the system (feedback loop), role of discrete information estimation in steering and the 'black box' according to which the human body can be monitored like a servomechanism, separated from its surroundings (Wiener, 1961). For Wiener, cybernetics was a method through which information systems build organisations between neuron networks and human communities (Peters, 2016, p. 17).

Wiener's message had a number of similarities with the thoughts published by Alexander Bogdanov 35 years earlier, which were banned during Stalin's rule. Consequently, in a Stalinist manner, Soviet Union started attacking cybernetics, using philosophical criticism as the tool. Cybernetics was characterised as idealistic and imperialistic and as an ideology directed against the interests of the working class. Because Bogdanov had already been branded anti-Soviet, a separate campaign against cybernetics was launched in the Soviet Union. According to Gerovitch, the word 'cybernetics' did not even appear in the 1953 edition of the Great Soviet Encyclopaedia, which contained all the information that Soviet citizens were allowed to access (Gerovitch, 2002, p. 103). In 1950, the journal 'Literaturnaya Gazeta' characterised Norbert Wiener as a *"conman and a plotter, the kind of a person that capitalists use instead of genuine scientists"*. According to the same journal, the computer enthusiasm in the United States was a *"huge campaign aimed at fooling the ordinary people"*. In a 1952 issue, the journal used such terms as *"American pseudoscience"* and *"the science of modern-day slave masters"* to characterise cybernetics. In 1954, the compact dictionary of philosophy described cybernetics as a *"reactionary pseudoscience"*. According to Gerovitch, this campaign did not arise from the clash between cybernetics and Soviet science but it was prompted by the ideological struggle fought as part of the Cold War (Gerovitch, 2002, pp. 118–119). However, according to Gerovitch and Susiluoto, at the same, the Soviet Union continued to develop computers and their usefulness in military applications was recognised (Susiluoto, 2006, p. 110; Gerovitch, 2002, pp. 119–121).

After Stalin's death, the Soviet Union was supposed to become a state for all its citizens, and the aim was to return to the idealised model of 'Leninism'. This atmosphere provided a fertile ground for cybernetic utopias (Susiluoto, 2006, p. 143) because in scientists' view, a technocracy, in which computer-aided administration could prevent a rule of terror, would be an ideal replacement for Stalin. In October 1956, the Soviet Academy of Sciences arranged a seminar discussing industrial automation, which was the turning point in the development of cybernetics in the Soviet Union. Lyapunov delivered two reports to the seminar, one on the mathematical basis of the science of accounting and the other on machine translation. In his view, the key issue is the 'algorithmisation' of control, or converting control and management into a chain of logical steps that could be transferred to a computer. Lyapunov characterised the construction of algorithms as a key issue and described cybernetics as a research field at the core of this particular problem. If computers are at the heart of automation, cybernetics would be at the heart of each computer (Gerovitch, 2002, p.194).

Until then, ideological criticism had been directed against cybernetics at all levels but now the situation was completely reversed. Cybernetics was eagerly embraced by a large number of Soviet mathematicians and computer specialists who considered criticism of cybernetics as an ideological conspiracy (Gerovitch, 2002, pp. 194–195). In 1958, an entry on cybernetics appeared in the Great Soviet Encyclopaedia. It was written by Andrey Kolmogorov, a Soviet mathematician, who enthusiastically characterised cybernetics as not only a collection of mathematical tools but also as a separate discipline, which in terms of its systematic construction, was still in its infancy (Gerovitch, 2002, p. 196). Norbert Wiener's work 'Cybernetics' was translated into Russian in 1958, and at the same time, Lyapunov launched the publication series 'Problemy kibernetiki' (Problems of cybernetics) (Gerovitch, 2002, pp.196–197).

According to Gerovitch, support for cybernetic ideas came from two opposite camps. The philosophers defending cybernetics wanted to place dialectical materialism inside cybernetics. Cyberneticians did not attach much importance to the philosophical dimension of cybernetics and instead, they emphasised its experimental validity and practical uses. At the same time, however, the lack of ideological clarity meant that Soviet cyberneticians had to define their field of science in the face of continuous opposition (Gerovitch, 2002, p. 197; Peters, 2016, pp. 39–40).

By the end of the 1950s, the 'objective' computer telling the truth had became the ideal and provided the basis for the budding cybernetic discourse. Mathematicians and computer specialists started to develop a new science that would combine a number of cybernetic theories, such as the regulatory technique, information theory and accounting theory into a single conceptual umbrella theory. Step by step, Soviet cyberneticians turned the earlier criticism on its head and tried to cyberneticise all fields of science. According to Gerovitch and Peters, this was a much more ambitious goal than what Norbert Wiener had tried to achieve with cybernetics. Cyberneticians also wanted to incorporate objectivity into all social sciences and in their view, the vague language of ideology should have been replaced with the precise language of cybernetics (Gerovitch, 2002, p. 199; Peters, 2016, pp. 36–37).

High walls had been erected between different fields of Soviet science during Stalin's rule. Each of the fields of science was dominated by one officially approved school of thought. Epistemic obstacles between different fields of science boosted the intellectual and institutional authority of the official schools of thought (Gerovitch, 2002, pp. 200–201). In opposition to this, cybernetics became the main instrument in Soviet science in the efforts to bring down the obstacles between different fields of science. Soviet scientists worked hard to achieve 'cybernetisation' of contemporary science (= to systematically translate scientific discourse into a cyber language).

In fact, in the late 1950s and early 1960s, cybernetics developed into an umbrella under which mathematicians, computer engineers, biologists and physiologists met, sharing theories, methods and hypotheses. According to Leonid Kraizmer, cybernetics "embraced all fields of science - not completely but to the extent that we are talking about process management". In line with the official version of dialectical materialism, Kraizmer, too, considered philosophy as the overarching theme but in his view, cybernetics is the only field of science that is not subjected to philosophy (ibid., pp. 200–201).

Alexey Lyapunov, who headed the cybernetic movement, first in Moscow and then in the secret city of Akademgorodok in Siberia, worked to institutionalise cybernetic research. Lyapunov contacted Aksel Berg, who had just retired from the post of Soviet Deputy Defence Minister for Radioelectronics, suggesting that he should accept the chairmanship of a cybernetic council operating under the auspices of the Soviet Academy of Sciences. This marked the start of the development of cybernetic ideas in the Soviet Union, and the efforts were spurred by the forceful personality of Berg (Gerovitch, 2002, pp. 204–206).

Driven by the cybernetic ideology of Aksel Berg, equipment of Sergey Lebedev, programming ideas of Alexey Lyapunov, and the equipment and networks of Viktor

Glushkov, rapid progress was achieved in cybernetics and computerisation in the Soviet Union during Khrushchev's rule and in the years immediately after his ouster. There were plans to introduce cybernetic applications to all areas of life so that we can talk of a real breakthrough of cybernetic utopias (Gerovitch, 2002, pp. 143–144). This was also the period when Vladimir Lefebvre was working at the institute of cybernetics and the idea of reflexive control first emerged. It was only possible in an atmosphere that was more favourable to the development of cybernetics and systems theory. The groundwork for the current Russian theories of the fundamentals of the command system was also laid during those years.

Boosted by the development of cybernetics, there was keen interest in computer science topics and scientific decision-making in the Soviet Union in the late 1950s and early 1960s. Until then, decision-making was considered as an art based on experience and intuition. Ideological conviction and party allegiance were also seen as playing a role. When the lessons learned from the Great Patriotic War were assessed, it was concluded that the risks arising from wrong decisions were becoming higher. Thus, the aim was now to quantify decision-making and increase automation in technologies and industries (Chotikul, 1986, p. 84).

2.1.2 The Soviet development in cybernetics, systems and control theory

Development of cybernetics in the Soviet Union was hampered by the lack of a clear definition of the concept. In an article published in 1955, Lyapunov, Sobolev and Kitov defined cybernetics on the basis of three theories: information theory, theory of computers as brain-like self-organised processes, and automated management systems. Three years later, Lyapunov and Sobolev gave four different definitions for cybernetics:

1. Cybernetics is a field of science that uses mathematical methods to study control systems and control processes.
2. Cybernetics is a field of science that studies control and management processes in equipment, living organisms and human communities.
3. Cybernetics is a field of science that studies the transmitting, processing and storing of information.
4. Cybernetics is a field of science that studies methods creating, transforming and interpreting the structure of real control process algorithms.

In 1959, the same authors published a new article that no longer contained the second definition. Even though this definition had been closest to Norbert Wiener's original definition of cybernetics, Lyapunov and Sobolev felt that the differences between regulatory technique, information theory and computer science would disappear if it was included. In Lyapunov's view, all intelligent activities involve regulatory processes managed by a control algorithm that can be implemented using a computer (Gerovitch, 2002, pp. 246–247).

Andrey Kolmogorov criticised the versions of Wiener and Lyapunov, describing them as too simple. In accordance with his own theory, Kolmogorov considered information as the key concept in cybernetics and defined other cybernetics-related is-

sues on its basis. Kolmogorov's definition of communication is essential in this respect. In his view, communication means 'reception, storing and sending of information' that manifests itself in two forms: control and regulation. In control, the information received is processed into control signals whereas in regulation, the information received is processed into regulatory signals. Sergey Yablonsky, a mathematician and Lyapunov's student, gave still another definition for cybernetics. In his view, each control system can be defined with the help of algebraic logic (Gerovitch, 2002, pp. 247–248). These thoughts may have provided the basis for the method suggested by Lefebvre (presented later in this study), in which decision-making is modelled with solvable equations.

The conclusion in the Soviet Union was that its model of cybernetics now differed significantly from the original Western concept. According to Soviet scientists, this was not a problem, however, as such theories as the 'control system' produced by Lyapunov and Yablonsky were considered much more detailed than the control concept presented by Wiener in his model. In Wiener's model, the sole purpose of control was to achieve a greater degree of organisation. According to Lyapunov, a system controls another system if the signal sent by it changes the behaviour of the other system. In Yablonsky's view, control systems are a broad category, which also includes the systems that actually exert control, systems that are controlled and systems that are not connected with control in the traditional sense (such as chess) (Gerovitch, 2002, pp. 249–250). In the final analysis, it can be said that cybernetics was not explicitly modelled but all definitions contained the need to model simple systems, links between them and exchange of information.

By the early 1960s, Soviet cybernetics was already a universal method that was used to interpret science, technology, economics and even politics. One manifestation of this was the way in which 'control' a basic concept in Wiener's theory was translated in cybernetic discourse. In the early 1950s, Soviet critics of cybernetics translated it directly into Russian, using the term 'kontrol'. However, in 1958, supporters of cybernetics translated the same word as 'upravlenie' ('management'). 'Control' is a more limited concept, and the new translation was introduced to show that cybernetics can contribute to administrative decision-making (Gerovitch, 2002, pp. 253–254; translation of the word 'upravlenie' is also discussed in the introduction).

From the military perspective, the link between systems theory and cybernetics in the Soviet Union became clear in the 1960s as 'military cyberneticians' viewed military systems (equipment and the humans operating them) as cybernetic systems. Already in 1958, Lyapunov had noted that cybernetic control algorithms were fighting against other algorithms. According to a definition presented in a 1972 book on decision-making, every platform (tank, aircraft and ship) and all its elements constitute a cybernetic system. The commanders and their control devices operate the control system, the weapons and the technical components of the platforms are the systems that they control, and the commanders and their staff constitute the systems controlling the troops. The units or platforms subordinated to the commanders are the systems to be controlled. Researchers studying the military applications of cybernetics proposed that computers and cybernetic control should not only be used in autonomous weapons systems but also in the command of military units (Gerovitch, 2002, p. 265).

In fact, the first information technology centre operating under the auspices of the Soviet Ministry of Defence was the first facility to study automated command of troops. In the opinion of cyberneticians, computers can make more objective decisions than individual commanders because computers do not base their decision-making on intuition but on collective information and on a broader operational-tactical view in specific areas. However, in the 1960s, these views did not yet lead to a cybernetic revolution as conservative military leaders forced the reformers to leave the armed forces. In the same connection, the first information technology centre became an ordinary scientific research centre expected to support the automation of individual military functions, instead of the automation of decision-making (Gerovitch, 2002, pp. 266–267). The activities were, however, continued, though in a smaller scale.

The ideas suggested by Bezuglii and Gavrilenko in the journal 'Military Thought' in 1991 can be considered as the culmination of the Soviet development of cybernetics and the starting point of cybernetics development in Russia. The two discuss the incorporation of the models of systems theory and cybernetics presented in the preceding years into military systems. Bezuglii and Gavrilenko conclude that Soviet cybernetics and the general systems theory developed by Ludwig von Bertalanffy do not offer a common definition for 'system' and that instead, a number of different definitions exist. The authors viewed this as a challenge and proposed that instead of a separate military systems theory, the general applicability of the system-theoretical processing should be understood (Bezuglii & Gavrilenko, 1991).

Accordingly, they proposed the following definition for a military system: "a group of elements that executes or supports the execution of a mission in a military operating environment". In their view, the 1991 Gulf War showed that military operations are becoming part of international politics and are directly related to problems at political level and not only to military problems. For this reason, it is essential that the focus in the modelling of systems is not only on battle systems but that consideration should also be given to overall political developments. In fact, the authors urge that armed forces should be developed on the basis of thoroughly constructed modelling based on workable theories (Bezuglii & Gavrilenko, 1991). The ideas of Bogdanov and Chekinov discussed at the start of this chapter are a natural continuation of these thoughts.

2.2 Russian military principles of command and control

Military leadership is always influenced by general attitudes towards leadership. These thoughts arise from the history of the country and its armed forces, combat experience and traditions. The principles of military command and control applied in Russia are discussed in this subchapter. Later in this study, these principles are combined with the cybernetics discussed earlier with the aim of modelling the overall concept of command and control.

A series of articles published in the journal 'Voennaya Mysl' in 2002 and 2003 provides a general description of what is expected of a military commander. The author, Major General Vorobyov, has contributed to the journal since 1957, and he has also

written a Russian book on tactics. The 2002 edition of the work is used as a basic textbook by officers studying tactics (cf. Thomas, 2016, pp.12–13).

In accordance with dialectics, Vorobyov states that commanding officers who understand the nature of battle and the objective laws guiding it, can understand what is happening, orientate themselves correctly and assess the situation. This forms the basis for their decision-making and the command process as a whole. However, in his view, it is wrong to think that all battles are similar and to reach conclusions from the course of a single battle. In fact, he suggests that the purpose of the military theory is to identify the law-like elements that are repeated in each battle and use them as a basis for instructions and recommendations. The principles of warfare provide military commanders with an opportunity to combine objective and subjective dialecticism in their own action. The principles are of passive nature, and do not guarantee victory but they have helped to construct scientific forecasts and anticipate results of the decisions (Vorobyov, 2002a, pp. 18–19).

According to Vorobyov, if a commander is able to act with skill and anticipate developments, shows determination and tenacity and uses unorthodox methods, the combat capability of his troops can be doubled or even tripled. To achieve this, the commander must defeat the enemy, prevent its actions and force it to act in accordance with his own will (Vorobyov, 2002b, p. 64). Continuing on the same topic, he notes that the ability to foresee developments in the battlefield is the greatest manifestation of a commander's skills. Decision-making and planning lie at the heart of military leadership: the victory must be planned well ahead of the troop deployment itself. This is based on realistic predictions, the ability to foresee the enemy's strengths and the combat capability of one's own forces (Vorobyov, 2003, p. 57).

According to Vorobyov, today's commanders must see any changes much earlier and analyse them more thoroughly than commanders in the past. His conclusion is that anticipating situations is based on the following principles: objective situational assessment, tested and scientifically verified methodology, systems analysis and careful analysis of conflicting information. All conclusions should be based on reliable indicators, calculations and convincing logic (Vorobyov, 2003, p. 58).

Strong trust in existing models is reflected in Vorobyov's writings, as in his view, commanders should always be able to rely on calculations and logic. A commander and his staff should work to eliminate all unanticipated developments and their aim should be to get the upper hand in the battle. To achieve this, stratagems and demonstrations should be used to control the enemy's action. Vorobyov, too, is of the view that computers cannot foresee everything. However, using the best available automated methods, a ratio of 1:6 or even 1:7 between plan and coincidence can be achieved (Vorobyov, 2003, pp. 59–60).

Vorobyov also discusses the concept of time pressure. In his view, estimating the time available is an important part of the decision-making process and it is extremely important to be able to command troops in a dynamic manner, make quick decisions and delegate the tasks to lower-level officers. Quick decisions are not crucial as such; what matters is the ability to make correct assessments. Vorobyov also notes that

both sides fight for time and for this reason, the commander should prevent the enemy from winning by disorganising its troops, by deceiving them and by exploiting the disarray and the low level of readiness among the enemy. To gain time, it is crucial that one acts more quickly and in a more dynamic manner than the enemy (Vorobyov, 2003, p. 60).

Control or at least the sense of being in control is essential in authoritarian and totalitarian systems, and there are also references to it in the Russian political tradition. Vorobyov also highlights the role of control, noting that the ability to manage the process of executing combat missions is key to the process of command and control. Control involves three phases: organisation, planning, and the direct presence of commanders as the lower level officers are carrying out the missions. According to Vorobyov, such control mechanisms help to ensure that all parties involved carry out their duties in accordance with a uniform plan (Vorobyov, 2003, p. 63).

Vorobyov notes that the control must be uniform, and it must have a purpose. It should be carried out so that it prevents incomplete or wrongly timed execution of tasks. It must be quick and effective so that commanders can react to problems before it is too late. Control mechanisms should support the combat operations led by the lower level officers by eliminating errors identified in the organisation and during the combat. At the same time, however, pedantic control should be avoided as this would make the lower level officers less prepared to show initiative. Exercising control is not only the commander's responsibility as it is also the task of the deputy commander, staff officers, officers in charge of branches of service and other commanding officers. Control can be exercised in many different ways but the best approach is to ensure that the commanding officers are present where the lower-level officers are placed (Vorobyov, 2003, p. 64).

Other principles of warfare relevant to command and control discussed in this study are based on the articles written by Vorobyov and Kiselyov in 2008 and 2011. The articles discuss the development of the principles of warfare

In their articles, Vorobyov and Kiselyov discuss extensively the changes in the principles of warfare but highlighting the command and control of troops during combat as a principle of warfare is of relevance to this study. According to the two, the complexity, inconsistency and the unique nature of today's operational situation force military commanders to apply creative thinking because otherwise, other principles of warfare could not even be used. At the same time, Vorobyov and Kiselyov are of the view that as fighting progresses, it becomes increasingly difficult to apply strict command principles, and they highlight the combat activities directed against command and control in recent wars (Vorobyov & Kiselyov, 2008, p. 87).

In contrast to Soviet thinking, Vorobyov and Kiselyov emphasise the need to minimise casualties and material losses in military operations. They suggest that in its current position, Russia cannot use its armed forces in the same way as the Soviet Union, and the focus should instead be on constant readiness, decentralisation of materiel and flexible deployment of troops in any part of Russia (Vorobyov & Kiselyov, 2008, p. 89). In fact, Russia has observed this principle as it has enhanced the capability of its armed forces over the past ten years.

Vorobyov and Kiselyov highlight the information-psychological support for strategic operations as a separate principle of warfare. In their view, it is a new and extremely effective component of supporting operations. The instruments used in such support include imposing one's own will on the adversary, using military policy and diplomatic means to deceive the enemy, gathering information on the high-security targets of the enemy and collecting information on one's own troops for the command system. These support measures also include protecting one's own troops against the information disseminated by the adversary and spreading disinformation among the enemy troops (Vorobyov & Kiselyov, 2008, p. 89).

Vorobyov and Kiselyov continue on this theme in their article on network-centric warfare (2011), noting that there is a gradual shift from the control of troops towards control of battle, in which the aim is to exert reflexive control over the enemy. At the same time, the principles of warfare are changing, and consideration must be given to integrated control of troops and systems as a new principle. In such situations, the commander must be able to take into account all links between the elements influencing combat action and to anticipate their impacts (Vorobyov & Kiselyov, 2011, pp. 74–75).

The expectations placed on a military commander and the principles of warfare described above show that the Soviet emphasis on unitary leadership and the commander's role, combined with a solid logical and mathematical chain of reasoning and the ability to identify causal chains, still have a strong influence on how military leadership is viewed in Russia.

However, it should be noted that the way in which military commanders are expected to deploy troops, and provide them with support have changed since Soviet times: the aim is now to minimise both casualties and material losses. This principle is supported by the emphasis given to information and psychological operations: they help military commanders to achieve their goals without casualties to their own troops. More importance is now attached to command and control as it has been realised that applying them in a constant and flexible manner is a prerequisite for achieving any military success. In this connection, Kiselyov has in a latter article also pointed out that tools should be in place to keep secret all personal details of military commanders to ensure that they could not be easily targeted in the social media (Kiselyov, 2017, p. 7).

Like their Western counterparts, Russian military commanders are under constant time pressure and the critical importance of time and the need to make decisions more quickly than the adversary are emphasised in decision-making. However, unlike in Western mission-type tactics, military commanders are expected to keep an eye on their subordinates so that any deviations from the plan can be identified at an early stage and correct action ensured. Nevertheless, it was already noted in the Soviet Union that excessive control has detrimental effects as subordinates became passive and the pace of action slows down (see for example, Ivanov, Savelev & Shemansky, 1977, p. 123; Vorobyov 2003, p. 63).

2.3 Russian command and control systems

The systems of military command and control developed in Russia can be assessed by combining the ideas arising from cybernetic modelling and systems theory with the principles of command and control. Systems theory was already extensively studied in the Soviet Union, and despite the problems resulting from changes in leadership and administrative structures in the 1990s, the work has continued on a comprehensive basis. Below is a presentation of the division of systems used by F. G. Kolomoyets, who has written extensively on systems analysis and decision-making within systems in Russia and Belarus. The focus here is on the principle of reflexive system analysed by Kolomoyets. This is followed by a discussion of the overall system of command and control and its subsystems.

In his article in the journal 'Voennaya Mysl', Kolomoyets divides systems into simple, complex and large ones. In his view, military organisations are among the most complex systems in existence. Kolomoyets adds that the systems theory has identified five empirically perceived operating principles of systems each of which is highly complicated (Kolomoyets, 2007, pp. 222–223). The operating principle of reflexion is the most complex of these five principles. Kolomoyets explains that in accordance with the reflexive operating principle, a system can make decisions and organise its activities by taking into account the decisions of another complex system interacting with it. In this case, reflexion is understood as the reflexion of the adversary's analytical decision-making process. The decision-maker of the first system might deliberately influence the fundamentals of decision-making in the other system and in this way, encourage decision-makers in that system to make decisions that are to its own advantage (ibid., p. 225).

Kolomoyets notes that systems organised in accordance with the reflexive principle can be called reflexive systems. In his view, battle systems are classic examples of reflexive systems that achieve their goals by carrying out their own combat missions in armed combat against the enemy's battle systems (ibid., p. 225).

In this way, reflexivity has been introduced to system-theoretical discussion in Russia, and it can be used as a basis when examining decision-making systems in accordance with Kolomoyets's principles: have they been deliberately built in accordance with the reflexive principle?

The article by Vygovsky and Davidov, published in 2017 in the journal 'Voennaya Mysl', can be considered as a general description of the Russian system of military decision-making and its subsystems. Vygovsky and Davidov discuss the automation of decision-making systems and support systems.
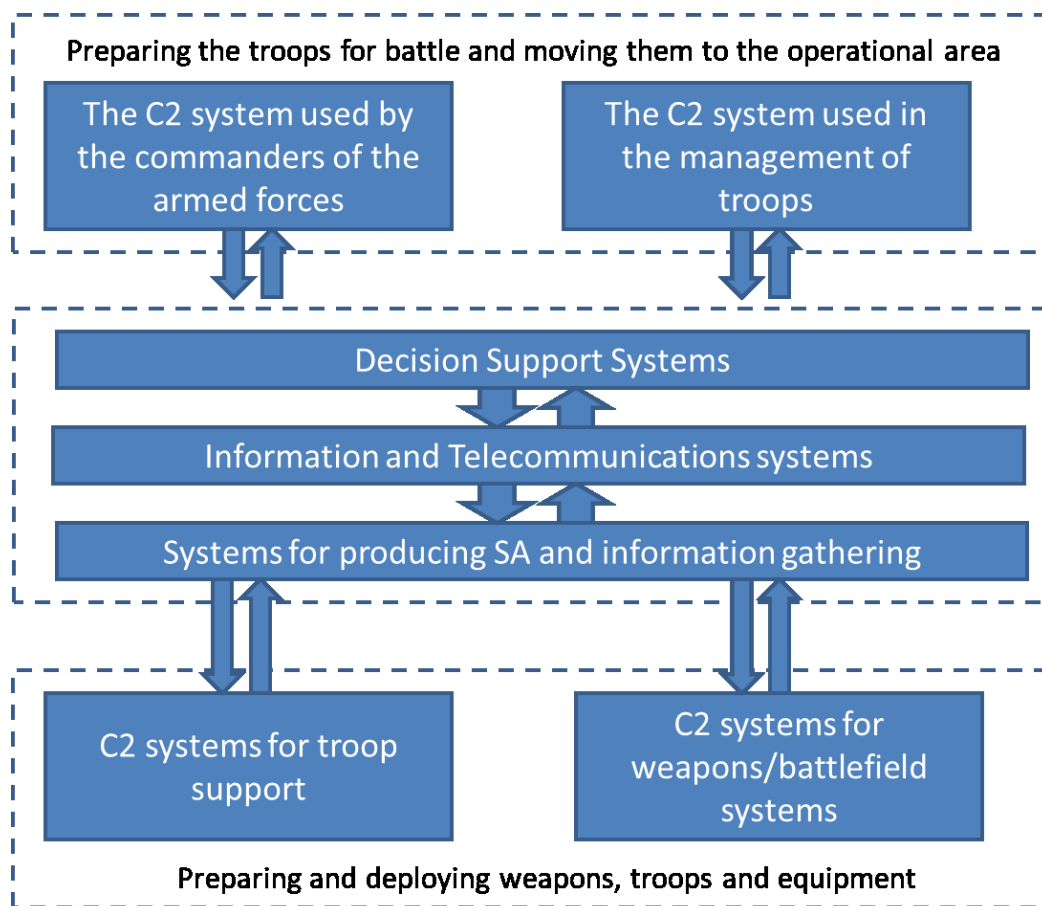
FIGURE 1: Structure of military command and control (Vygovsky & Davidov, 2017).

In the context of this study, it is necessary to examine the functioning of the two key subsystems: the command and control (C2) system and the decision support system. These systems comprise the human decision-makers and the systems that can, when influenced, directly contribute to the effectiveness of reflexive control.

A figure illustrating the basic features of a command system and its elements is shown below.
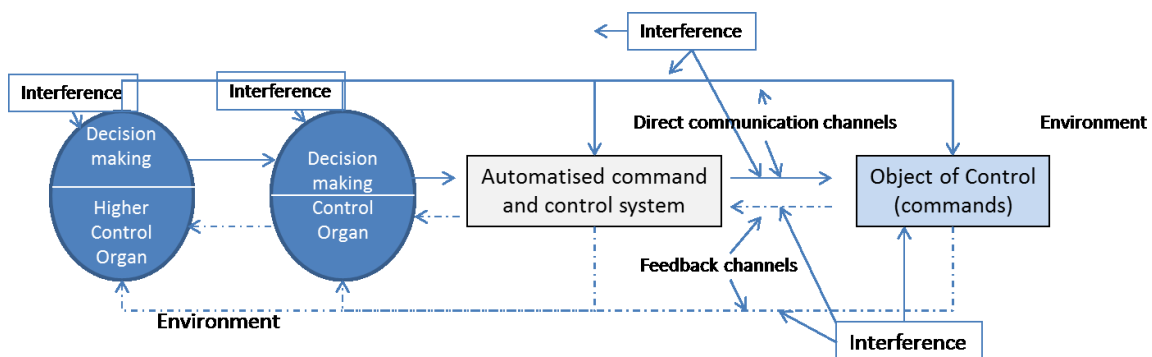
FIGURE 2: Expanded version of the command system (Ivanov, Savelev & Shemansky, 1977)

21

According to Ivanov, Savelev & Shemansky, the main task of the control organ is to obtain information on the state and functions of the object of control. In principle, control would be impossible without such information and the absence of the information will ultimately lead to a conflict with the objective reality and the destruction of the system (Ivanov, Savelev & Shemansky, 1977, p.12).

The authors note that when the process of command is analysed from the perspective of materialistic dialectics and cybernetics, the following can be said (irrespective of the operating environment and the method of implementation):

- It is absolutely necessary to have a command system comprising the control organ, an object of control and direct communication and feedback between the two.
- There are causal relationships between the components.
- The functions of the command system are goal-oriented and require the existence of control parameters.
- The system is of dynamic nature, and it is capable of transformation. At the same time, it is also able to absorb a large number of external inputs without its internal structure or characteristics being affected (Ivanov et al., 1977, p. 16).

Using the definition produced by the above mentioned study, the command system can be assessed on the basis of the division proposed by Kolomoyets in his article. According to this division, systems capable of functioning in this manner can be categorised as complex reflexive systems, which means that they take into account decisions made by the adversary in their own actions and try to achieve a higher degree of reflex.

Dovzhenko and Zavgorodni discuss the structure of decision support systems in their article 'Decision support in the control of troops'. According to the authors, all evidence shows that human brain has only limited processing capacity and for this reason, it has become necessary to develop specialised systems for decision-makers. Dovzhenko and Zavgorodni suggest that these systems are created through a variety of different technical solutions, and they can be used to combine existing practical information with information-technology solutions and to create new processes for collecting, sharing and processing information (Dovzhenko & Zavgorodni, 2014, p. 109).

According to Dovzhenko and Zavgorodni, the ability to produce decision-making models that can be entered into databases should be the key feature of the decision support systems. The system must provide a basis for the construction of an extensive model database and for easy and simple creation of new models founded on existing ones (Dovzhenko & Zavgorodni, 2014, p. 112).

Tikhanitsev, who works at the research department of the Russian military administration and actively contributes to the debate on research issues, has written about developing decision support systems for automated administration. He notes that in the context of the systems theory, the individual who decides to launch an operation (battle) merely adjusts the control parameters in order to construct a strategy allowing

weapons systems and troops to achieve the goals set by the commander (within the limitations set). If there is only one solution to such a system-level problem, it can be determined by means of direct calculations (Tikhanitsev, 2012, pp. 75–76).

However, Tikhanitsev admits that in combat troops are rarely in such a situation. If there are not enough troops or weapons, the goal can rarely be achieved with the prerequisites set. In such cases, in order to achieve a solution, new values for the target function (goal) must be calculated or estimated or some of the limitations must be adjusted. In that case, a rational solution can be achieved but solving the equation involves a large number of changing parameters and producing the calculations is difficult. Reaching a solution may prove impossible unless the decision-makers use the capabilities offered by automated support (Tikhanitsev, 2012, p. 76).

According to Tikhanitsev, when such difficult calculation problems are encountered, the common practice in many countries is to use decision support systems or expert systems. Decisions on military and military-policy matters that place enormous responsibility on individual decision-makers are primarily taken on the basis of decision support systems. Tikhanitsev notes that Russia does not have a standardised decision support system and suggests that such a system is needed (Tikhanitsev, 2012, p. 77). In fact, there has been progress after the publication of Tikhanitsev's article. For example, the new national defence command centre relies heavily on computer-aided decision support systems.

The article by Donskov, Nikitin and Besedin on intelligent decision support systems for electronic warfare is relevant to reflexive control. In their view, decision support systems used today are typically built as expert systems that support decision-makers without them having to take any active measures. In the authors' view, the risk here is that the adversary can manipulate these automated systems with its signals. They note that as systems become more extensively automated, it becomes increasingly likely that there are attempts to control them on a reflexive basis. According to the authors, a decision support system may in itself exert reflexive control over the enemy and protect one's own system against the control attempts made by the adversary (Donskov et al., 2015, pp. 136–137).

The articles discussed above suggest that there is a great deal of interest in decision support systems in Russia and intensive development work is underway. In general, decision support systems can be characterised as complex systems that collect information on such matters as their operating environments, on the enemy and on one's own troops and that use this information as a basis for analysis and recommendations.

2.4 Russian military decision-making

Despite automated command systems and decision support systems, humans still remain behind all decision-making. The work by Ivanov, Savelev and Shemansky presents the Soviet view on human decision-making. After they had raised the topic, it was discussed in Russian military journals in the 1990s and the early years of the 2000s, while the conclusions were analysed by Lester W. Grau and Charles Bartles, two American researchers, in their work 'The Russian Way of War' published in 2016.

The authors approach decision-making from the perspective of the decision prepared by the commander for the battle. In their view, the commander's decision must be based on the following: his psychological capabilities, level of knowledge, experience and knowledge of the situation, the time available for decision-making and combat preparations, the troops available to the commander and the nature of the orders issued by the higher-level commanders (Ivanov et al, 1977, p. 171).

According to Ivanov, Savelev & Shemansky when the conditions are difficult, the purpose of the decision-making methodology is to help the commander to produce correctly timed and well-justified definitions of the basic structure of operations, and the tasks for the lower levels of command and the models of coordination between them. For this purpose, the methodology must meet a number of requirements that arise from the operating environment and the decision-making process itself (Ivanov et al, 1977, p. 185).

They add that the methodology of the commander's decision-making and the contents of his decisions always depend on the following base values: the orders issued by the higher levels of command and its instructions on how to prepare for the combat, changes in the situation (especially the time available for decision-making) and the personal characteristics of the commander and his subordinates (ibid, p. 186).

They also emphasise that analysing and describing the reasoning behind individuals' decisions is extremely problematic, especially when we are talking about commanders in difficult situations. The commander's train of thought is often divided into three separate and successive phases: first he analyses the task, then he evaluates it and, finally, makes the necessary decisions. The authors do not share this view because in their opinion, it is not in accordance with the reality, advanced methods or the theory of cognitive science. The separate and successive nature of the three factors can be questioned. In fact, it is more a matter of perception than reality (ibid., p. 187). Since then, the same problem has also been studied in Western research on human decision-making. Examples include the Recognition-Primed model by Klein, in which experienced decision-makers usually make their decisions very quickly on the basis of similar situations in the past and without analysing different options (Klein, 2008, pp. 457–458).

In the context of this study, it is essential to understand the Russian concept of how a commander makes his decisions. Ivanov, Savelev & Shemansky support the view based on dialectical materialism, in which human awareness is a reflection of the objective reality. In other words, a 'soul' does not exist. This means that the decision-making process, like any other intentional activity, must start with sensory observations of the real situation, after which it must change into abstract thinking and, finally, into action. The authors consider this as a dialectical method of observing reality, as a process of perceiving the objective world. Failure to act in accordance with this cognitive model will lead to serious errors, especially if these errors have been made by higher level commanders and the errors made by the decision-maker are added to them (Ivanov et al., 1977, pp. 198–199).

The authors note that, as a result, specifying the commander's tasks and assessing the situation are not separate phases but a uniform and creative decision-making process. The assessment of the situation does not start after the specification of the task but

it continues and deepens so that all advantages and disadvantages of the options are fully understood. Searching for the right option should start at the beginning of the decision-making process and during the process, an experienced commander is able to determine which of the options are feasible. The commander weighs up the remaining options (2–3) at the conclusion of the decision-making process, assessing the estimated end results (own and enemy casualties, attrition of material resources, allocation of time, etc.), and selects the best option. At this stage, both the mind and the will of the commander matter. The worst option is to decide not to decide (to do nothing). After selecting the best option, the commander transforms it into an order and makes his decision known to the lower levels of command. The decision-making process is now complete (Ivanov et al., 1977, pp. 200–201).

The authors note, however, that the decision resulting from this process (like any decision) is only of relative importance. In their view, the most important of the decision-making methods presented above is the perception of reality in accordance with dialectical materialism. When decisions are made, it is also important to use theoretical methods of logical thinking, such as analysis, synthesis, abstraction, generalisation, induction, deduction, analogies and comparisons, all together or as combinations (Ivanov et al., 1977, pp. 202-204).

After the dissolution of the Soviet Union, a slightly critical look was taken in Russia at these command theories, which seem rather sterile when examined from the Western perspective. The article by Volostnov and Golod in the journal 'Voennaya Mysl' is an example of this, and it also touches on the problems of managing troops, a topic already discussed above.

Volostnov and Golod put together earlier concepts in their search for the core idea of command and control. In their view, command is an intentional, creative, organisational and a technical process that is put into practice by commanders and their staffs. It creates impacts on the troops subordinated to them. The ultimate goal of command and control is to organise troops for their combat missions and to ensure that they can effectively carry out their combat missions within the time allocated to them and with minimum losses. Secondly, when examined through the cybernetic perspective, all command takes place in a closed cybernetic system, in which objects in contact with each other transmit information in an appropriate manner. Thirdly, the command process is part of the military system. In this connection, the principles defining the content of 'control' are those that define the functioning of complex military systems (Volostnov & Golod, 1992).

In his article in the journal 'Voennaya Mysl' in 2001, Major General Ryabchuk outlines the principles for commanding troops in the 2000s and in doing this, he also touches on the theories of reflexive control. Ryabchuk, who also holds a doctoral degree in military science, starts by noting that in the Soviet tradition, control was seen as a peacetime activity carried out by commanders and their staffs to keep the troops combat-ready and to prepare them for battle. He criticises this approach by stating that it does not contain the idea of controlling the enemy's activities through one's own action. In his view, great military leaders have always worked to exert control over the

enemy as part of their own military strategies. In military theory, such action is considered as part of battlefield support measures, such as deception and disguise, and not as a crucial element of battle (Ryabchuk, 2001, pp. 13–14).

According to Ryabchuk, the enemy should not merely be considered a target for reconnaissance and influence operations. In his view, it is clear that the enemy, too, tries to identify and destroy critical targets, disrupt command and control activities as well as to deceive and disguise and that the enemy, too, wants to achieve victory. The commander should be prepared for this. Ryabchuk quotes Tukhachevsky, Marshall of the Soviet Union, in whose view, only the party whose combat operations proceed according to plan is exerting control over the troops. Thus, proper control of the battle cannot only be a matter of exerting control over one's own troops but, in a sense, it should also involve exerting control over the enemy (ibid., p. 14).

Ryabchuk admits that until now, it has been possible to criticise this approach but the information technology of the 21st century and advances in reconnaissance methods also open up tremendous opportunities for exerting control over the enemy. According to Ryabchuk, the problems concerning troop control nowadays arise from the need to organise command and control in interaction between two complex, dynamic and mutually hostile battle systems. These battle systems, which are structured both hierarchically (units) and horizontally (branches of service), share the same goals, troops and instruments in the efforts to achieve their goals, the same information and, above all, the intellectual capabilities and goal-orientation of the commander. According to Ryabchuk, intellectual capability is the key weapon and crucial to achieving victory over a well-armed, well-equipped and well-trained enemy (Ryabchuk, 2001, pp. 14–15). Makhnin, whose writings are presented later in this study, has reached similar conclusions.

Ryabchuk concludes his article by noting that today's military commanders have access to more systems helping them to select the best possible options when making decisions. Nevertheless, in his view, success in the battlefield is guaranteed by the personal characteristics of a military commander, which comprise a high intellectual capability, high ethical standards, and psychological and professional capabilities. When available in sufficient quantities, these characteristics provide a basis for an effective approach to command and control (Ryabchuk, 2001, p. 17).

To sum up the above discussion, the role of humans in decision-making is recognised in Russia (as it was already recognised in the Soviet Union). However, in the past, this was not a factor highlighted in the manuals. Even though the personal experience of military commanders and its use in decision-making were emphasised in the books and articles published in the Soviet Union, this was not accompanied by practical proposals. Universal objectivity as a guiding principle in dialectical materialism and assessing situations merely on the basis of objective reality may well have been a factor contributing to this. In the articles written after the dissolution of the Soviet Union, there has been more emphasis on thinking and social relations between individuals even though they, too, use idealistic and lofty concepts when talking about human beings. There is no mention of human weaknesses or the stress arising from combat. Command is seen as a successive process or as a process carried out in parallel with the latest information systems. Intellectual capabilities and imposing one's will on the

enemy emphasised by Ryabchuk in his article should be seen as a continuation of Soviet thinking. However, he also discusses the use of information technology and engaging in combat against an enemy with superior resources.

Generally speaking, the commander still plays a key role in Russian decision-making. Lester Grau and Charles Bartles, two US researchers, make the same conclusion. They note that commanders that have studied in Western military organisations cannot just put on a 'red hat' and expect to understand the way in which Russian military commanders and staffs work. The role of Russian military commanders and staffs in decision-making substantially differs from the Western practice and focusing reflexive control on commanders and their personal characters is partially based on this. As noted by Grau and Bartles, in the West, a weak commander can manage if he has a competent staff. However, this would not be the case in the Russian system (Grau & Bartles, 2016, pp. 51–54).

2.5 Reflexive model of command and control

Based on the theories discussed above, a system-theoretical and cybernetic model of the Russian approach to command and control has been prepared for this study. It consists of 1) human decision-makers (commander and his staff) who are influenced by the conflict and the nature of the conflict, as well as military leadership; 2) the decision support system supporting the staff in its decision-making; 3) command and control system with its information relay and feedback channels; and 4) the system subordinated to the commander and the corresponding system of the enemy. This system functions in interaction with the operating environment and the corresponding cybernetic systems above and below it. The overall purpose of the system is to exert influence on the corresponding system of the enemy at different levels, and it also takes into account the functions of the enemy's system. Disruptions arising from the external operating environment or enemy action also impact the systems used in the model.
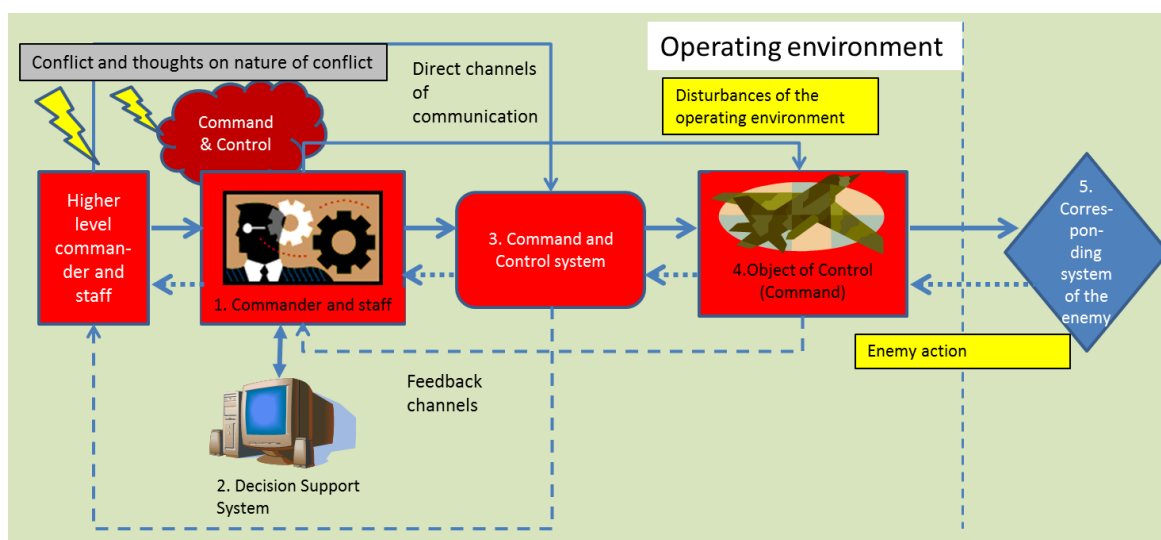

FIGURE 3: Reflexive model of the military command and control system prepared in this study

We can only understand the Russian theory of command and control if we understand the efforts to automate this system as comprehensively as possible. As noted by Grau and Bartles, the primary Russian goal has been to optimise decision-making in accordance with the needs of maneuver warfare, in which situations change rapidly and flexibility is required. To achieve success, a commander cannot use complex planning processes and rely on thorough staff work as the system must be based on clear orders issued on time by a commander with a good understanding of the situation. Moreover, the orders must provide instructions for using the operating models for which the troops have already received training and that are applied in the combat. Likewise, according to the Russian view, comprehensive automation of command and control helps commanders to make decisions more quickly than the enemy (a quicker completion of the O-O-D-A loop). According to Grau and Bartles, the Russian commander-centred decision-making is better suited for such automation than the processes used by NATO and the United States, which require a greater degree of human involvement during the planning process. On the basis of the goals described above, they note that in Russian decision-making, the aim is to prepare a plan based on training already carried out, under which the combat mission can be executed in an optimum manner and not to create a tailored plan for perfect execution of the task (Grau & Bartles, 2016, pp. 57–58).

In the context of this study, it is important to identify the potential targets for influence operations in this highly automated command system, which is designed for quick commander-centred decision-making. It can be concluded from the above that the commander is likely to be the prime target and the staff the secondary target. This is because influencing them will impact the whole system (in the same way as exerting influence on a higher-level commander). Influence on the commander and his staff can be exerted through their thoughts (command and control and thoughts about the conflict as background factors), through the plans that they have prepared (the aim is to influence the fundamentals of the plans), or through decision support systems (solutions advantageous to one's own side are fed into the decision-making process). Efforts may also be made to exert direct influence on individuals (especially the commander). Efforts may also be made to influence the command system, even though this will produce more limited results. The ultimate method of exerting influence on the enemy is to cause more disruption in the operating environment. All these options are discussed in the dual model of reflexive control.

2.6 Theory of reflexive control

When the ideas of Vladimir Lefebvre, the man behind the original theory of reflexive control, are adapted to the reflexive systems discussed above, it can be noted that at system level, reflexive control is a process in which two opposite (military, political or economic) reflexive systems try to reach a higher level of reflexion than the other system possesses. In this process, the system with a lower level of reflexion is in a reacting position and unable to determine the real intentions behind the adversary's action. In military systems, it may involve a confrontation between command and battle systems, at political level, a struggle between two opposing coalitions, and at economic level, a struggle between two competitors operating in the same market.

However, from the perspective of the methods used, the definition is not precise enough and does not provide answers concerning practical action. For this reason, this report will examine how the theory and practice of reflexive control have evolved over the past 50 years, and this is done by delving into the background assumptions and development of reflexive control. The author relies on the division of the development of reflexive control into four distinctive phases used by Timothy Thomas in his 2002 article 'Reflexive Processes and Control'. Thomas divides the process into the research phase (from the early 1960s to the late 1970s), practical orientation (from the late 1970s to the dissolution of the Soviet Union in 1991), psychological-pedagogical phase (1990s) and the psycho-social phase (from the late 1990s) (Thomas, 2002, p. 61). Developments in the 2010s are discussed separately because in recent years, consideration has been given to ideas and models that did not appear in the earlier writings.

The author discusses the roles of individuals that have contributed to the development of the reflexive control theory, such as Lefebvre, Lepsky and Novikov (all civilian researchers) and Druzhinin, Ionov, Kontorov, Leonenko, Chausov and Makhnin (all military researchers) (cf., Chotikul, 1986, p. 80; Thomas, 2004, pp. 239–240; Thomas, 2011, p. 121; Thomas, 2015; Thomas, 2017). The approach is mainly based on their writings, and their original ideas and the references to these ideas and writings in later articles on the topic have been used as the selection criteria.

2.6.1 Philosophical and political background to the reflexive control theory

When reflexive control is examined on a comprehensive basis, we should consider the social situation where the development work started and how the concept is expected to function. Vladimir Lefebvre, the man who developed the theory (and who later moved the United States) notes in his book 'Algebra of Conscience' that the differences between the Western and Soviet societies went much deeper than generally assumed. This comment is used by the author as a basis for examining the societal assumptions behind reflexive control. According to Lefebvre, these differences already manifested themselves in the background assumptions concerning good and evil (Lefebvre, 1984a, pp. 6–8). According to Chotikul, Lefebvre refers to the differences between the two systems in the areas of ethics and morality (Chotikul, 1986, p. 23; Lefebvre, 1984a, p. 87).

According to Lefebvre, declaration of absolute good was at the core of the Soviet ideology: a good human being is honest, morally pure, modest, and has simple needs. The existence of evil was not denied; in fact, it could be used if that was necessary to secure victory for the good (in other words, the end justified the means). Maintaining an enemy image was one of the instruments used to emphasise the moral good in the Soviet system and the character and extent of the Soviet propaganda was one manifestation of this (Lefebvre, 1984a, pp. 83–91). It seems that the same operating model is also behind Russia's current information operations targeting its own citizens (cf. Hakala, 2018; Gessen, 2018).

The emphasis in the Soviet system was on control, which required long-term planning and anticipation. In the economy, this manifested itself in five-year plans, in the Soviet armed forces in cybernetic theories of troop control and predictions that the whole

system of command and control would be automated. Background assumptions of dialectical materialism also led to a holistic and systemic approach to the issues concerning ordinary Soviet citizens. All phenomena were interpreted through dialectical materialism, and in accordance with this approach, all real-world phenomena were seen as influencing each other. This interaction was supposed to result in the real objective world, which was seen as being reflected in human conscience (Chotikul, 1986, pp. 29–30).

Chotikul suggests that the Soviet Union was still basically a peasant society in the 1980s where people had the capacity to endure hardship and were willing to submit to authority. As a result, Soviet citizens were well aware that they had little say in their country's affairs. Chotikul suggests that these values are part of the Russian search for "*an integral outlook which would give an answer to all questions of life, unite theoretical and practical reason and give a philosophical basis to the social idea*". According to Chotikul, this need was one of the factors that prompted the Soviet system to adopt the systems theory and cybernetics in a more comprehensive scale than Western countries (Chotikul, 1986, p. 40). In his own study, Gerovitch notes that cybernetic concepts were incorporated into dialectical materialism to ensure that the comprehensive nature of cybernetics could be combined with the philosophical world view (Gerovitch, 2002, pp. 257–260).

In her own study, Chotikul suggests that the philosophy of dialectical materialism also explains the functioning of the Soviet control system. According to dialectical materialism, human awareness is a reflection of social existence in a community. It is social (not private) awareness (Spirkin, 1983, Chapter 3). Against this background, the best way to exert control over individuals is to influence the observations that they made of their environment. The more firmly beliefs can be embedded in the cultural context in which decision-making occurs, the greater social control becomes. In this way, reflexive control can be applied to influence the opinions of both adversaries and the citizens of one's own country. According to Chotikul, reflexive control represents an extension of the concept of reflection in the Marxist-Leninist philosophy (Chotikul, 1986, p. 45). An example of this is the situation in the 1980s, in which the cultural context within which decisions were made had been successfully shaped by the Soviet system. As a result, the 'cognitive map' of most people now only contained the decisions that the leaders wanted them to make (ibid., p. 47). The nostalgia felt for the Soviet Union in the present-day Russia shows that these efforts were at least partially successful (Gessen, 2018, pp. 176–182).

A clear ideological duality helped to rationalise the restrictions and prohibitions that were imposed on Soviet citizens. When examining the developments presented later in this study, it should be remembered that maintaining an enemy image and the belief that there are dark and sinister forces opposing Russia is deeply ingrained in Russian folklore and the system itself. By exploiting the cognitive dissonance built into the Soviet system, Soviet leaders were able to project the hatred of Communism onto Western imperialists, while at the same time, citizens could identify themselves with their leaders (Chotikul, 1986, p. 58). This same confrontation and projection are still used in Russia to maintain the enemy image (see for example, Gessen, 2018, pp. 464–468).

According to Chotikul, the projection of hate arising from the theory of cognitive dissonance creates the need to control the awareness of the subjects. At the same time, it can be used as an argument to support Lefebvre's concept of 'multiple-tier awareness', in which individuals are directly aware of their inner world, while at the same time they are also aware of the awareness of their own inner world (Chotikul, 1986, p. 59).

In order to understand the theory of reflexive control, we should also understand the Russian concept of 'leader' ('вождь', vozhd), which was commonly used to describe such figures as Stalin and which is now also occasionally used when references are made to Putin (see for example, Berdy, 2018). People identify themselves with the leader, and he is idolised by reinforcing the division into 'good and evil' discussed above: the leader is presented as pure, and he is above all suspicion, fear or guilt. Even though the leader can act in an arbitrary or coercive manner, the end justifies the means and even cruel acts may be needed to combat the anarchy on the opposite side (Chotikul, 1986, p. 60).

In Lefebvre's view, the concepts of reflex help to describe leadership in such a community. According to his theory, all members of the community act in a restricted reality, while the leader also acts in a special reality of his own. He plans his actions, projecting the plan onto his own reality, and starts to put it into practice. This can only be done if the leader can, in addition to the actions taken by the members of his own community, also identify the factors influencing his own actions (Lefebvre, according to Chotikul; Chotikul, 1986, p. 62). The example given by Lefebvre aptly describes the differences between the concept of Western and Soviet leadership. In the West, the leader is seen as an influential member of a group guiding its activities, whereas in the Soviet Union/Russia, the leader is the only member of a group who makes decisions. This has also similarities with the special status of the commander in Russian military decision-making discussed above.

In the context of reflexive control, it is also important to understand the role of 'doublethink' (Двоемыслие) in Russia and the former Soviet Union. As the Communist Party controlled official thinking and expression, Soviet citizens had to make a distinction between private and public life. In accordance with the concept of doublethink, people deliberately lived (and still live) in a way that contradicts their own beliefs or they adjust their ethics to their needs, daily comforts or career aspirations. This is relevant to reflexive control in that people living in such a system are more inclined to accept manipulation of the truth as it does not have any direct impact on their own lives. Doublethink, combined with fundamental immorality and a pervasive dialectical approach provided the real basis for the Soviet system, and its impacts are still felt in the present-day Russia (Chotikul, 1986, p. 66; Gessen, 2018, p. 72–74, pp. 299–301).

The expressions 'half-lie', 'white lie' and 'tactical truth' (Kari, 2018) or vranyo (*враньё*), a widely used concept in Russia, are also part of the same cultural context. Even the authorities use it in censorship and when keeping information secret. Half-lies always have some truth in them, which makes them more effective. According to Chotikul, reflexive control is easiest to achieve and implement in a society where lies, half-lies, suspicion and secrecy are accepted and natural elements of social reality. At the same

time, Chotikul also suggests that reflexive control could be incorporated into social control because the Soviet system was characterised by a suspicious, control-oriented and complex relationship between an authoritarian government and citizens expecting authoritarian leadership (Chotikul, 1986, p. 86). It is safe to say that this still characterises the relationship between the Russian people and its leaders (Gessen, 2018, pp. 301–304).

In order to function properly, reflexive control also requires understanding of the Russian practice of secrecy and deception (*maskirovka*) and the principle of risk avoidance behind it. In accordance with the principles of maskirovka, the enemy must also view reflexive control measures as probable, and they must match its ideas of Russian doctrine and strategic assumptions. Understanding these assumptions is an important part of the methodology of reflexive control. For example, Kahneman notes that cognition is primarily influenced by standardised processes used by individuals to make decisions and perceive their environments (Kahneman, 2003, pp. 699–700). These processes result in cognitive errors as they get into contact with entirely unknown matters. For this reason, it is important to understand the motivations and strategies behind the actions and not only rely on assumptions (Chotikul, 1986, pp. 69–73). In the context of risk avoidance, Chotikul suggests that the Soviet Union was a risk-averse society and for this reason, one of the main aims of the reflexive control was to minimise risks and to make situations more predictable for decision-makers (ibid., p. 75).

To sum up the section on societal background assumptions, it can be said that control has always played an important role in Russia, because of reasons arising from the operating environment, history and social factors. As a result, the factors behind reflexive control have existed for decades but until the 1960s they were used intuitively and subconsciously and not within the framework of a comprehensive theory. Contrary to what Chotikul suggests (ibid., pp. 76–77), reflexive control cannot be considered as an inevitable development or something that is built into the Russian mindset. Instead, this study attempts to show that after the terror reign of Stalin, there was a need to develop a system of ruling over the country's citizens that was not based on mass executions and prison camps. Because of social background factors and the cybernetic visions discussed above, there was a need for reflexive control in the Soviet society, which prompted systematic research on 'soft' influence operations. This research and the influence operations may first have been directed at the country's own citizens after which they were incorporated into the planning of military operations and the use of military force (Pynnöniemi, 2018, cf. Peters, 2016, p. 4).

2.6.2 Research period, 1960s - early 1970s

Theoretical development of reflexive control (research period) had its origins in cybernetics research carried out in the Soviet Union during Khrushchev's rule in the 1960s. With his pioneering work in those years, Vladimir Alexandrovich Lefebvre (b. 1936) made an important contribution to the development of reflexive control.

Born in Leningrad, Lefebvre received his academic degree at the physics and mathematics faculty of the Lomonosov Moscow State University and started his research career in the early 1960s in the first computer centre operating under the auspices of

the Soviet Ministry of Defence, His research topic at the facility was applied military cybernetics (Lefebvre 2002, p. 83; Chotikul, 1986, p. 86; Semenov, 2017, p. 609). At the same time, he also took part in the work of the logics research group known as the Moscow Methodological Club (MMC). Lefebvre continued the work on problems concerning human thinking launched in the MMC by Stsedrovitsky and Aleksejev and presented his own interpretation of the solutions. He also attended conferences of psychologists and philosophers where he gave his original presentations of reflexivity. Lefebvre started studying reflexive processes in conjunction with the pioneering methodological research carried out in the MMC and the research on psychology and ergonomics carried out in practical military environments (Lefebvre, 2002, p. 83; Semenov, 2017, p. 609).

By the year 1963, Lefebvre had reached the conclusion that the decision-making modelling systems used at the time were incomplete. In his view, the classical game theory could not simulate reality because in it, each of the actors made its decisions independently without giving any consideration to the adversary's decisions. He started studying the logic of 'reflexive games' and presented a modelling system that differed from the game theory. Lefebvre's system comprised three subsystems, one of which was the simulation of the adversary's decisions. In response to his critics, in whose view one should keep one's own and the adversary's decisions separated, he proposed the concept of reflexive control. According to Lefebvre, the adversary always uses information about the other side when making decisions. A situation where the other party tries to shape the information to suit its own needs will lead to a model where the confrontation is examined through objective and subjective factors (Lefebvre 1984b, pp. 7–9; Semenov 2017, p. 609). Thus, the dialectics of Russian thinking extends to the fundamentals of reflexive control.

The following year, Lefebvre proposed that decision-making elements should be modelled using location-based indexing. Such elements as goal, doctrine, 'map' and decision were given numeral indices to ensure that decision-making could be presented in concise form as an iterative mathematical process. When different factors were presented as mathematical symbols, algorithms and algebra formulas could be used to describe decision-making processes, which eliminated the challenges and vagueness typical of natural languages and graphics. Lefebvre called these calculation formulas 'reflexive equations' (for a simple example of such equations, see Appendix 1). These ideas presented by Lefebvre were tested and were found to be efficient and to contain a great deal of creativity. In fact, the theory of reflexive control attracted a great deal of interest, and it was favourably received, especially in military circles where its advantages and potential were quickly recognised (Lefebvre, 1984b, pp. 5–31). Lefebvre's cybernetic approach to reflexive systems was also appreciated in academic circles, and he discussed the results of his studies in respected publications of the Soviet Academy of Sciences (1965) and in the first edition of 'Systems Research', the philosophical-methodological annual publication of the institution (1969). He was also invited to take up a distinguished scientific post in the Central Economics and Mathematics Institute of the Soviet Academy of Sciences (ЦЭМИ) (Semenov, 2017, pp. 609–610).

Lefebvre was not alone in his interest in the topic, and parallel to his work, he set up an unofficial group of like-minded individuals for psychological-cybernetic research. The group had the following members: V. E. Lepsky, G. L. Smoljan, P. B. Baranov and A. F. Trudoljubov (Semenov, 2017, p. 609). Most of them would play a role in the development of reflexive control.

According to Lefebvre, the use of his reflexive equations would require a new approach to conflict. Instead of examining a conflict as interaction between two opposite systems (such as armies), Lefebvre's model saw a conflict as interaction between two decision-making processes determining the way in which the armies act. In this model, a conflict is examined as reflexive action between the opposing parties, which can be modelled as reflexive equations, provided that all options available to the parties are identified (Lefebvre, 2010, p. 143; Reid, 1987, p. 294). In that case, reflexion means that each of the parties formulates its decisions by modelling its own and the adversary's decision-making and the options available to them. Lefebvre's research produced algorithms and structures for studying this reflexive interaction.

In Lefebvre's view, control over the enemy is an indirect process: *"Control over the adversary's decision-making, which ultimately means imposing a specific behavioural strategy on the adversary through reflexive interaction, is not the result of a direct process, and it cannot be achieved by using force. It can be achieved by providing the adversary with grounds for making logical decisions that have been predetermined by the other party. Transferring the grounds for decisions means linking X to a reflexion specific to Y's situation: In this way, X can start exerting control over the decision-making process. The process in which the grounds for decision-making are transferred from one party to the other is called reflexive control. All diversion (provocation, lying and deception) is the result of reflexive control."* (Lefebvre, 1967, pp. 33–34).

Reflexive Control:
$$\Omega y = T(situation) + \Omega x$$
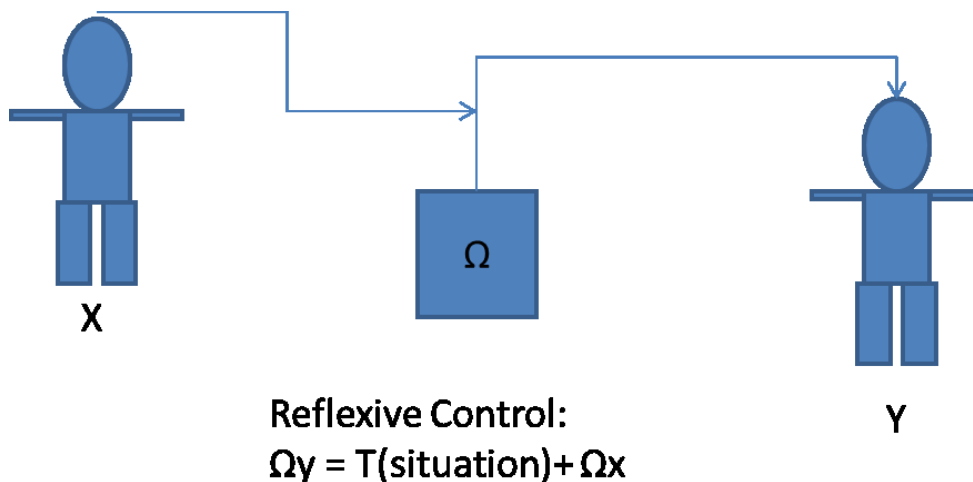
FIGURE 4: Linking X with Y's decision-making process (Lefebvre, 1967)

In the late 1960s, Lefebvre described the above model of thought based on equation solving and its relationship with second-order cybernetics. In his view, it was possible to separate structures (objects), the complexity of which corresponded to the observer's own complexity. For example, in such cases, a military commander can act as a researcher analysing the enemy army that his forces are facing. According to

Lefebvre, the commander can start his analysis by modelling the geographical location of the enemy army and the structure of its actions. However, this analysis is not enough to solve the commander's problem. According to Lefebvre, the main goal of the commander is to determine the enemy's plans and ascertain the extent to which the locations and operational structures of the enemy army are real, and the extent to which they are the result of deception aimed at encouraging the commander to make the wrong decisions. In this example, the commander must reflect on the inner world of the object that he is studying (Lefebvre, 1967, pp. 9–10).

According to Lefebvre, the difference between the researcher (the commander), and the object of his studies becomes blurred at this stage. An external observer who considers himself a person studying an object is in a difficult position: what can he do if the object that he is studying is also studying its adversary (ibid., pp. 9–10)? Thus, Lefebvre's thinking is in line with second-order cybernetics, in which there is a 'system of an observer' outside the relations between previous systems (Novikov, 2015, pp. 17–18; cf. Lefebvre, 2002, pp. 84–85).

According to Lefebvre's own definition, the other party gains an advantage if it has information on the adversary's situational assessment, and if it knows how the adversary uses its own doctrine to analyse the situation. In this case, it is possible to construct a solvable equation of the options available to the decision-makers. It is particularly important to be able to influence the adversary's situational awareness, his goals or doctrine and to ensure that the adversary does not notice the influencing attempts (Lefebvre, according to Chotikul; Chotikul, 1986, p. 78). In an article published in 2002, Lefebvre writes that he had independently developed a second-order cybernetic concept which could be used to examine the impact of information on a system that was aware of itself and the system exerting influence on it (Lefebvre, 2002, pp. 83–84).

Lefebvre's definitions contain the core of reflexive control: the first part (gaining advantage) describes the goals, and the second part (exploiting the situational assessment and information) the method. The conclusion in the Soviet Union was that the focus in effective decision-making must be on the mind of the adversary or its operational code. This required the ability to reflect the inner world structure of the party to be controlled and the ability to create credible models of its behavioural strategy. In such situations, reflexive control means emulating the adversary's decision-making by understanding the factors behind it. The ultimate aim is to disrupt the adversary's 'decision-making algorithm' and exert control over it. It was realised in the Soviet Union that the 'quality' of the adversary's decision-making was irrelevant, because reflexive control could be applied if the elements and content of the decision-making could be modelled sufficiently comprehensively (Chotikul, 1986, pp. 78–79). It was also observed that the effectiveness of Lefebvre's equations in fundamental psychological and applied military environments provided a basis for defeating an enemy that relied on the classical game theory founded on a traditional strategy (Semenov, 2017, p. 610).

The reflexive control developed by Lefebvre comprised two parts: reflexion, which comes from psychology, and control, which comes from cybernetics. Reflexive control could be used to exert influence on the adversary's activities, and it could be

applied if the adversary's cognitive map was thoroughly understood. In this case, objective observations of the situation made by the adversary could be modified without the adversary noticing anything. To achieve the situation described above, the attention should be on psychological aspects and subjective factors characteristic of the adversary (Chotikul, 1986, p. 79).

In his 2002 article, Lefebvre notes that there were fundamental differences in the way in which second-order cybernetics evolved in the Soviet Union and the West in the 1960s. In the Soviet Union, it developed into the conceptual basis for influencing the enemy's decision-making process (Lefebvre, 2002, p. 85). Lefebvre emigrated to the United States in 1974, but his work was continued in the Soviet military and civilian sector (Semenov, 2017, p. 610). The development of the military applications was continued by such officers as Druzhinin, Deputy Chief of the Soviet General Staff, and his colleague Kontorov. They followed on Lefebvre's ideas and concluded that exerting control over the enemy required in-depth knowledge of the enemy's policies, ideology, military doctrine, goals, organisation, psychology, bilateral relations, and emotions, as well as the state of its troops and the personal characteristics of its military commanders. These could be made into a filter through which the information used by the commander in his decision-making was filtered (Druzhinin & Kontorov, 1976, pp. 199–201). 'Orientation' (Boyd, 1996) is a similar concept used in Western research into decision-making.

Lefebvre's ideas and the book by Druzhinin and Kontorov did not remain the only contribution to the debate on reflexive control at this stage, as the topic was also discussed in military journals. In an article on how to influence the enemy's decision-making published in the journal 'Voennaya Mysl' in 1971, Major General M. Ionov notes that influencing is possible if the plans and intentions of the enemy are revealed. According to Ionov, the enemy can be persuaded to make decisions that are to one's advantage based on the following conditions: the enemy is placed under pressure; influence is exerted on the enemy's situational assessment, decision-making algorithm, and the way in which it selects its goal; and influence is exerted on the timing of the enemy's decision-making. Placing the enemy under pressure is the easiest condition to understand. Its aim is to influence the psychological state of decision-makers and to persuade them to avoid combat. Disguise, deception, unexpected new instruments, and changes in troops are used to influence the enemy's situational assessment (Ionov, 1971, p. 165).

It is difficult to list any specific ways of influencing the enemy as it selects its goals. To use them, a commander must have a high intellectual capacity, and possess intuition and experience. He must also apply logical thinking and understand history and doctrine, as well as possess information about the specific characteristics of the enemy commanders. These instruments are used to counter the deductive decision-making of enemy commanders. Commanders base their decisions on limited information, and if uncertainty concerning real goals is maintained for a sufficiently long period by presenting a range of different options, the commander has no time to determine which is the right one. Such action makes it more difficult for the enemy to determine its goals. Thus, it also disrupts the enemy's decision-making algorithm (Ionov, 1971, p. 166). Ionov uses the same terms as Lefebvre (such as decision-making algorithm).

In his article, Ionov describes links between control, psychological warfare, and battlefield support. In his view, the methods applied in the West show that when methods for exerting control over the enemy are planned, both psychology and the social systems for which the methods are intended should also be understood. In line with dialectical Soviet thinking, Ionov also asks whether Western countries are publicising their methods to deceive the Soviet Union.[2] Ionov concludes his article by noting that influencing the enemy's operations constitutes a complex logical problem that can only be solved if a large amount of information is processed. This is beyond the capabilities of the commander and his staff and automated systems are required for the work (Ionov, 1971, pp. 169–171).

In his own article, Ionov does not mention reflexive control by name, but Berezkin, who continues with the same topic, introduces the concept to the debate. In Berezkin's view, Ionov was correct in noting that success in battle can only be ensured if the intentions of the enemy can be ascertained. According to Berezkin, heuristic methods helping to construct decision-making formulas should be applied to ascertain the enemy's intentions (Berezkin, 1972, p. 183). Here, Berezkin draws on Lefebvre's thoughts on formalising decision-making and giving it a mathematical basis. Berezkin continues by noting that different types of information are the key to exerting control over the adversary's decision-making. This information must constitute the objective truth of the battle, irrespective of what the commander or the opposite side think of it. The key point is to define the information collected by automated systems and the amount of information collected to ensure that one's own side can exert influence on the enemy's decision-making at an early stage. According to Berezkin, such redefinition of control-related problems requires new terminology. In his view, 'controlling reflexes' is the most accurate description of the control process that he is describing. This term describes the bidirectional nature of the process, in which the aim is not only to influence the adversary's mind but to prevent the adversary from doing the same. Berezkin continues by noting that controlling reflexes is based on probabilities, because the adversary does not necessarily use the information conveyed to it in the desired manner (Berezkin, 1972, p. 184). According to Berezkin, in selecting the best method, the commander must, in the manner described by Ionov, understand both psychological factors and political and social aspects (ibid., p. 185).

According to Lefebvre, in addition to the publicly available books and articles described above, secret development work taking place under the auspices of the KGB was also underway in the Soviet Union. He claims that a secret report based on Lefebvre's findings written by an agent named Panov was published in 1968, and that it marked the start of the process. That year, the KGB allegedly established its own facility to study reflexive functions. According to Lefebvre, the theory of reflexive control became classified information after the publication of Panov's report, which suggests that it was considered extremely important by the Soviet leadership (Chotikul, 1986, p. 90). The public debate in military journals and the books published on the topic do not lend credibility to Lefebvre's claim (Semenov, 2017, p. 609). However, the KGB may have developed reflexive control in a different direction, and the findings of this work remain unpublished. There are no references in other sources to such KGB involvement in the development of reflexive control, and no attempt to assess it is made in this study.

---

[2] cf. Klimenko's thoughts about the role of doctrine in deception, Klimenko 1997.

The research phase of reflexive control in the Soviet Union in the 1960s and 1970s can be summarised as follows: by the early 1970s, with the development of cybernetic thinking between systems (second-order cybernetics), the role of reflexive control directed at the adversary's decision-making had been recognised, the inadequacy of game theory in the modelling of real decision-making processes had been noted, mathematical modelling of decision-making had been developed under the auspices of Vladimir Lefebvre and MMC, and the need for automated and protected information processing as part of the control over the adversary's decision-making had been identified. However, the computers used at the time did not allow automated information processing to the same extent as today, although at concept level, the matter remained at the core of the reflexive control theory. Contrary to what Thomas claims (Thomas, 2004, p. 243), reflexive control was openly discussed in the Soviet Union in those days, as shown by the publication of the books by Lefebvre and Druzhinin & Kontorov, as well as a number of scientific conferences. Moreover, a definition of the concept 'Рефлексивное управление' can be found in the 1974 Encyclopaedia of Cybernetics (Glushkov, 1974, p. 296; refers directly to Lefebvre). Keeping its practical applications secret was apparently more important to the Soviet leaders than keeping the concept itself under wraps.

2.6.3 Period of practical orientation

Discussion of the practical applications of reflexive control continued in the Soviet Union in the 1980s. At the same time, after the period of détente in the 1970s, the United States under President Reagan showed renewed interest in Soviet military developments, and Soviet ideas of reflexive control were now studied in research institutions as part of general research on the Soviet military. In this subchapter, the author presents the conclusions of Reid (1987) and Chotikul (1986) in their research, original Soviet texts, English translations of Vladimir Lefebvre's books, and further research that he carried out after moving to the United States.

In 1984, Lefebvre presented the concept of two different ways of exerting control for the first time: the cognitive way, in which the aim was to change the processing of the information possessed by the enemy; and the informational approach, in which the messages conveyed to the enemy were selected. This concept was essential to the development of reflexive control in the decades that followed. This division is still used today. Lefebvre also divided control into two categories: constructive (creative) reflexive control, in which influence on the enemy or one's own citizens was exerted to ensure they voluntarily make the decisions serving the interests of the controlling party; and destructive reflexive control, in which the method was used to destroy, paralyse, or neutralise processes and algorithms used by the enemy in its decision-making (Lefebvre, 1984b, pp. 144–145). The author uses this division in the dual model of reflexive control presented later.

In 1976, Druzhinin and Kontorov, whose writings were discussed above, had concluded that the adversary's decision-making process was divided into four different factors: 1) the adversary's understanding of the situation; 2) goals; 3) solution algorithm (doctrine); and 4) the decision. The author has also used this division in the model of reflexive control (Druzhinin & Kontorov, 1976, p. 199).

The understanding of the situation contains the information on operational troops, the operating environment, earlier action, the current situation, and the goals and limitations of the parties. The understanding of the situation can be influenced through disguise, deception, and disinformation. The goals constituting the second phase of the process are an important part of decision-making, and they can be defined both in peacetime and during a conflict (Druzhinin & Kontorov, 1976, pp. 199–200).

According to the original texts compiled by Reid for his study, goal setting can be influenced in three ways. One is a show of force to convince the enemy that a goal is unachievable. A second is to demonstrate a threat of such significance that its countering dominates the enemy's goals. The third way is to keep the enemy in a state of uncertainty concerning one's own actions to ensure that none of its goals can guarantee a satisfactory outcome in all plausible sets of events (Reid, 1987, p. 295).

According to Druzhinin and Kontorov, the solution algorithm (doctrine) includes the norms of the adversary's behaviour, analytical operating models, the adversary's ways of describing and assessing the situation, and preparations for further action. It manifests itself in standardised operating models, methods, exercises and the lessons learned by military commanders (Druzhinin & Kontorov, 1976, p. 201). According to Reid, the conclusion in the Soviet Union had been that it is difficult to influence these factors through reflexive control. However, he also quotes Ionov (1971) in whose view, surprise is a way to influence the timing of the decision. It is extremely difficult to indirectly influence the decision itself and for this reason, the focus in reflexive control is on the first two phases of decision-making (Reid, 1987, pp. 295–296).

For his study, Reid collected details of reflexive control methods published in the Soviet Union that also appear in similar form in Lefebvre's writings (Lefebvre, 1984b). They reflect the situation prevailing in the Soviet Union in the 1980s, in which the focus was on the practical orientation of reflexive control (cf. Thomas, 2004, p. 238). To facilitate the practical application, each of them was accompanied by an example of past conflicts or other ways of applying reflexive control.

- Transferring a situational picture to the enemy: in this method of reflexive control, the enemy is conveyed a wrong or incomplete situational picture by means of deception, disguise or decoys (Reid, 1987, pp. 296–299).
- Creating goals or a doctrine for the adversary: in this reflexive control method, the aim is, by sharing one's own information, to put the enemy in a situation where its only options are also advantageous to one's own side (ibid., pp. 298–300).
- Transferring the desired decision: in this operating model (which requires trust and contacts between the parties), the aim is to force the enemy to make a decision that provides a basis for action on one's own side (ibid., p. 301).

These three operating approaches are simple models, in which the aim is to directly influence the adversary's situational assessment at specific stages of decision-making. The operating models described below are more complex because in them, the aim is to shape one phase of the decision-making process by controlling the adversary's understanding of another phase. Success in such actions requires extremely good understanding of how the adversary makes decisions (Reid, 1987, p. 301).

- Influencing goal formation by feeding a false situational assessment: feigning weakness so that the enemy can be lured into a trap is one application of this method (ibid., pp. 301–302). This model can also be used by controlling specific 'indicators' identified in advance that the enemy uses as a basis for its decision-making.
- Feeding parts of one's own situational assessments to the enemy: for example, controlled leaks concerning matters presented as important to one's own operations (ibid., pp. 302–303).
- Feeding details of imaginary goals to the enemy: the purpose of this method is to shift the enemy's attention away from one's actual goal to the desired goal (ibid., pp. 303–304).
- Feeding a fake version of one's own doctrine to the enemy: exercises, in which the troops are deployed differently than in the real situation are an example of this method (ibid., p. 305).
- Modifying one's own action so that the enemy gets a wrong situational picture: in this method, one takes a controlled risk and moves troops to an area from where no attack is planned. The assumption is that the enemy expects an imminent attack (ibid., pp. 305–306).
- Reflexive control of bilateral engagement by a third party: in this method (which is directed at decision-makers), a third party attempts to get two other parties into a situation that is advantageous to it (ibid., p. 306).
- Reflexive control over an enemy applying reflexive control: in this operating model, it is assumed that the adversary is using reflexive control, and the aim is to uncover its stratagems and to use them against the other side (ibid., pp. 306–307).
- Reflexive control over an enemy relying on the game theory: in this method, which is based on the conservative nature and inflexibility of the game theory and answers known in advance, inputs in line with these characteristics are fed into the adversary's decision-making process (ibid., pp. 307–308).

By the mid-1980s, it had become clear to Soviet actors that a comprehensive plan containing a response to every enemy move or random event would be critical to ensuring successful application of reflexive control. It had also been noted that the inconspicuous nature of reflexive control made it an excellent strategic-level tool to facilitate choices between different options (Druzhinin & Kontorov, 1976, p. 192). As Lefebvre himself wrote: "*In contrast to a scholarly debate, the most inventive liar wins in conflict*" (Lefebvre, according to Chotikul; Chotikul, 1986, p. 80).

It was also noted in the 1980s that reflexive control does not need a continuous feedback chain, which until then had been seen as an essential component in all cybernetic control systems. According to Chotikul, Soviet actors realised that feedback is useful

when the effectiveness of the control is assessed and errors are corrected but when receiving feedback is not possible, it can be left out (Chotikul, 1986, p. 81).

Chotikul notes in her report that one of the key findings is that underestimating the enemy and its reflexion capacity may substantially undermine the effectiveness of reflexive control methods. It is also important to understand that a variety of different techniques should be applied, and the same technique should not be used repeatedly. This prevents the enemy from deducing which methods and techniques are used and from developing appropriate countermeasures (Chotikul, 1986, p. 83).

There were many Western researchers in the 1980s holding the view that reflexive control cannot be developed into a scientific method as thought processes and psychological functions cannot be quantified in a precise manner, which would make such a theory ineffective (Chotikul, 1986, p. 96). With advances in computer technology and increases in the amount of data, this may actually now be possible. Nevertheless, already in the 1980s, researchers suggested that thinking on the basis of reflexive control concepts would provide a useful operating model. Understanding the enemy, analysing potential movements and counter-movements and the resulting need to develop a methodology providing a basis for analysing strategic problems and for making optimal decisions are the key features of such a model. In researchers' view, this already gave the Soviet Union a head start over the rest of the world, and it is also noted that orienting decision-making in accordance with reflexive control concepts may in fact be as dangerous to the enemy as applying the theory in practice (Reid, 1987, p. 309; Chotikul, 1986, p. 96).

The conclusion is that in the 1980s, the Soviet Union had been able to build a theoretical and practical basis for using reflexive control in the simulation and control of one's own troops and the enemy's decision-making process. It had been accepted as an instrument for military operations and training and its vocabulary was used in public debate, at least in the contributions made by military officers and cyberneticians. Lefebvre's emigration to the West and his book 'Algebra of Conscience' also increased awareness of the topic in the United States in the early 1980s where research reports on the subject were produced on the basis of publicly available Soviet sources. There was little discussion of the mathematical basis of reflexive control in these reports as the focus was on its practical aspects.

2.6.4 Psychological-pedagogical period

Following the collapse of the Soviet Union, the Russian armed forces were thrown into a chaos. For all practical purposes, the Soviet Union had been a military organisation spending most of its budget on external and internal security (Allen, 2001, p. 867). However, the disintegration of the Soviet Union did not stop the development of reflexive control as the research work continued. The reasons for this are discussed later but the author first takes a look at a number of articles in which the theory of reflexive control was taken further. Following on the Russian practice, Timothy Thomas has named this era the psychological-pedagogical phase (Thomas, 2002, p. 61). There was growing interest in reflexive psychology in the general Russia debate in the 1990s.

The status achieved by the concept of reflexion in the post-Soviet Russia is illustrated by the article by Lazarev in the journal 'Voennaya Mysl' in 1992, in which the author attempts to formulate a general theory of security. According to Lazarev, the United States uses information as a reflexive control instrument, and for this reason, information security of the state must be given a high priority (Lazarev, 1992). The same topic was discussed by Skvortsov, Klokotov and Turko in 1995. In their view, reflexive control is the most complex way of influencing decision-making at government level. They, too, refer to the inputs made by the United States in information technology and information warfare and in protecting information through legislation (Skvortsov, Klokotov & Turko, 1995). At the time, there was also discussion of the future shape of the Russian military doctrine, and Klimenko was one of those noting that an open doctrine should contain both descriptive and reflexive elements so that it can induce the desired reaction in the audiences (Klimenko, 1997). In other words, at this stage, reflexive control was seen as being used by the West but Western countries were not characterised as enemies but as models that should be emulated. In the 1990s, there were already differences between the Western and Russian approaches to the concept of information security (which later became a key component of Russia's security strategy).

'Reflexive control of the enemy' (Рефлексивное управление противником), written by Colonel S. Leonenko, is the earliest Russian article on the practices of reflexive control used in this study, and it has also been quoted in a number of Western studies (such as Thomas 2004, Giles, Seaboyer & Sherr, 2018). The article first appeared in the journal 'Armeiskij Sbornik' in 1995. According to Leonenko, reflexive control consists of transmitting motives and grounds from the controlling entity to the controlled system that stimulate the desired decision. The nature of these motives and grounds must be kept secret, and the controlled system must make its decisions independently. According to Leonenko, a 'reflex' means a specific process used to model the enemy's thinking or imitate its potential behaviour. A reflex prompts the enemy to make decisions that are to its disadvantage. Leonenko examines the 'filter' originally described by Druzhinin and Kontorov, which means the concepts, information, ideas and experiences used by the enemy commander as a basis for his decision-making allowing him to separate useful facts from irrelevant information, correct information from the wrong information, etc. (Leonenko, 1995, p. 28).

Leonenko adds a new dimension to the debate by noting that locating the weak point of this filter and exploiting it in one's own actions lies at the core of reflexive control. Like Druzhinin and Kontorov, Leonenko also notes that reflexive control makes use of moral, psychological and other elements, such as the personal characteristics of the commander. Biographical data, habits and psychological deficiencies can be used to create a picture of these personal characteristics, which can then be exploited in deception operations. According to Leonenko, in a situation where reflexive control is applied, the side with the highest degree of reflex (the side best able to imitate the other side's thoughts or predict its behaviour) will have the best chances of winning. The degree of reflex depends on many factors, the most important of which are analytical capability, experience and the scope of knowledge about the enemy. In his article, Leonenko concludes that disguise and deception have replaced the stratagems used in the past. Leonenko continues by noting that even though no official or formal terminology of reflexive control was available in the past, it has nevertheless been

intuitively used to deceive the adversary (Leonenko, 1995, pp. 29–30). In this, Leonenko agrees with the conclusions reached by Chotikul in her own study. It is not clear from the article to what extent Leonenko has drawn on Soviet-era literature but the vocabulary he uses is identical with that used by Lefebvre, Ionov and Druzhinin & Kontorov. Leonenko adds to their analysis by suggesting that 'filters' can be found in both human mind and computers. During the information age, filters are involved in the processing of both human and computer data (Leonenko, 1995, p. 29).

M. Ionov, now a retired General, continued his research on reflexive control that he had already started in the early 1970s. In an article published in the journal 'Voennaya Mysl' in 1995, he noted that the purpose of reflexive control is to influence or control the adversary's decision-making by ensuring that the adversary makes decisions that it has carefully analysed, and that lead to its defeat. Like Lefebvre, Ionov also concludes that reflexive control is more likely to bring success if the original plan of the enemy is known. In that case, the controlling side is better placed to induce the enemy to make wrong decisions by applying reflexive control methods. The aim of these methods is to reduce the enemy's decision-making time by all means possible and to bring about a surprise in the enemy's decision-making algorithms (Ionov, 1995a).

In a new approach, Ionov identifies a military coalition as an adversary. In his view, it is a much more complex system than an individual country. The stability and decision-making capacity of the coalition largely depend on how the situation is viewed by each individual member country. According to Ionov, there are such huge differences in thinking, goals, policies and ethics between these countries that each party must first determine how different ways of exerting influence could work against them (Ionov, 1995a).

Ionov had updated the four techniques of exerting control over the enemy that he presented in 1971 and now described them as follows: show of force, different ways of presenting a wrong situational assessment, influencing the enemy's decision-making algorithm and changing the decision-making time. In his view, these four techniques serve as a checklist for commanders at every level. In his article, Ionov lists a variety of different methods to apply these techniques. The first of them includes threats of different types such as sanctions, reconnaissance, testing of weapons, raising the readiness level of one's own troops, forming of coalitions, limited strikes, exploiting victories, demonstrations of brutality and mercy towards those who have given up fighting. In presenting a false situational assessment, the following methods can be used: concealment, construction of mock structures, changing of positions, Trojan horses, encrypting the communications between troops, keeping new weapons secret, bluffing with weapons and deliberately losing documents. The enemy can also be forced to act through provocation and deception or be forced to take time-consuming retaliatory action tying down its troops. Influence on the adversary's decision-making algorithm can be exerted by presenting a false doctrine, by acting in a deceptive manner on a routine basis, by striking at command posts and commanders, by conveying false background information, by continuously maintaining a high level of readiness and by taking measures against the enemy's operational thinking. Launching surprise attacks or to induce the enemy to draw hasty conclusions by persuading it to draw parallels with a past conflict are methods used to change the timing of decision-making (Ionov, 1995a).

Ionov continued on the same theme in his article 'Control of the Enemy' (Управление противником), which appeared in the journal 'Morskoi Sbornik' later in the same year. In this article, Ionov notes that in order to exert control over the enemy and to prevent the enemy from doing the same, information must be collected on the enemy troops, the nature of their operations and their capabilities. Ionov presents a number of different principles to exert control over the enemy. First of all, he emphasises the reflexive nature of the response: the commander should always visualise how the enemy can respond to the circumstances imposed on it. Secondly, the response may be problematic because the enemy may have noticed the control attempts, and takes countermeasures. Thirdly, Ionov emphasises the level of technical tools, especially reconnaissance. It has become increasingly likely that the measures directed at the enemy are exposed. Finally, Ionov urges the use of harsh measures to put pressure on the enemy and in his view, the priority in them should be on social, psychological, ethical and ideological considerations. According to Ionov, such measures could include deliberate brutality towards civilians or prisoners of war or unlimited submarine warfare (Ionov, 1995b, pp. 25–31).

Advances in technology and incorporating them into reflexive control and into the measures to counter it were also discussed in the articles published in the military journals. In the article already presented above, Colonel S. Leonenko notes that the use of computers may interfere with reflexive control because the measures may be more easily exposed. Speed and accuracy of the computers play a role in this though computers also have features that can be used when applying reflexive control. Computers lack the human ability of intuitive reasoning, and they can provide new opportunities for the use of reflexive control. In fact, in his article, Leonenko gives a new definition to reflexive control: **Reflexive control consists of transmitting motives and grounds from the controlling entity to the controlled system that stimulate the desired decision.** The goal of reflexive control is to prompt the enemy to make a decision unfavourable to it. Naturally, one must understand the way in which the enemy thinks (Leonenko, 1995, p. 28).

In Leonenko's view, computers open up new opportunities, and he notes that in today's situation, there is a need to act not only against people but also against technical reconnaissance systems and high-precision weapons. Unlike humans, technical systems do not try to analyse what is happening, and they do not perceive to what humans react (ibid., p. 28). In his article, Thomas asks whether this means that there are two layers in reflexively control: the first layer consisting of sensors and the other of humans. According to Thomas, one example of this was the war in Kosovo where Yugoslav forces fooled NATO sensors, which resulted in NATO shooting at fake targets (Thomas, 2002, p. 69). This is also shown in the model prepared for this study.

The article by Komov in the journal 'Voennaya Mysl' in 1997 is the last of the articles on the psychological-pedagogical phase used in this study. Komov's article has been quoted in a large number of documents on reflexive control. In his view, exerting reflexive control over the enemy is a form of 'intellectual' information warfare, and he lists basic elements of such an approach in his article. In information warfare targeting systems, the offensive elements of such intellectual information warfare include:

- distraction, which already creates a real or imaginary threat against an important enemy target during preparations for the battle – this forces the enemy to consider the soundness of its own operational plans;
- overload, in which the enemy is continuously provided with conflicting information;
- paralysis, in which the enemy is given the impression of a threat against an important interest or weak spot;
- exhaustion, in which the enemy is forced to carry out useless operations so that it is forced to enter combat with weakened resources;
- division, in which the aim is to convince the enemy to act against the interests of the coalition;
- pacification, in which the aim is to convince the enemy that pre-planned exercises (instead of combat preparations) are underway, leading the enemy to reduce its vigilance;
- deterrence, in which the aim is to create an impression of overwhelming superiority;
- provocation, in which the enemy is forced to act in a manner advantageous to one's own side;
- suggestion, in which the enemy is provided with information affecting it legally, morally, or ideologically;
- pressure, or distribution of information which discredits the enemy government in the eyes of its own citizens (Komov, 1997; Thomas, 2004, pp. 248–249).

Komov also lists the following defensive elements: gathering of information by all possible means (including military); and corroborating the information from more than one source (Komov, 1997).

Thus, the development of reflexive control continued in Russia in the 1990s, and there was also discussion of its practical applications. Compared with the Soviet era, Russian views on fighting from the position of weakness and fighting against military coalitions were more prominently reflected in the articles. At the same time, consideration was also given to technological advances and the use of computers in decision-making. Cybernetic research carried out in the Soviet Union had already created a strong basis for this, but the findings could now also be applied at a practical level: reflexive control was seen as warfare in which the focus was on influencing the adversary's decision-making. According to this study, there was no practical application of reflexive control in the Russian military operations in the 1990s, as the focus was on examining past events in world history. Moreover, there are no references to the mathematical modelling used by Lefebvre in these articles by military officers, as the issue is discussed against the background of operational applications.

2.6.5 Psycho-social period and observations from Russian operations

By the early 2000s, Russia had largely recovered from the chaos following the dissolution of the Soviet Union and was at least trying to use reflexive control in domestic counter-terrorism operations, such as the Dubrovka Theatre hostage crisis (Berger, 2010, p. 88). Parallel to the war against terrorism launched by the United States in 2001, Russia under Vladimir Putin was working to achieve rapprochement with the

West. In those years, there was more public discussion of reflexive control and reflexivity, and Russian researchers were engaged in close cooperation with their US counterparts. In 2001, Vladimir Lepsky, who had collaborated with Lefebvre since the 1960s, launched the publication Рефлексивные процессы и управление. Between 2001 and 2004, it also appeared in English under the title 'Reflexive Processes and Control'. In their articles and other publications, Lefebvre, Lepsky and other civilian researchers continued the discussion of how reflexivity could be used in nearly all scientific fields in Russia and elsewhere in the world. Timothy Thomas, a US researcher, who had already studied Lepsky's and Lefebvre's ideas, published his first article on the military applications of reflexive control in this journal (Thomas, 2002). It provided the basis for other articles on the same topic (such as Thomas, 2004 and Thomas, 2011). According to the author's findings, the articles and other publications by Thomas are the most frequently quoted articles on reflexive control in Russia and the West.

The article by Chausov entitled 'Fundamentals of reflexive control over the enemy' (Основы рефлексивного управления противником) has been used as the main Russian source for the psycho-social phase (Thomas, 2002, p. 61), and it has also been quoted in a large number of different publications. The article was published in the journal 'Morskoi Sbornik' in 1999. Chausov differs from other soldiers in that he also writes about theoretical aspects, whereas most other military officers focus on the methods of reflexive control.

In his article, Chausov defines reflexive control as **"the process of deliberately conveying to the opposing side of a certain aggregate information, which will cause that side to make a decision appropriate to that information"** (Chausov, 1999, p. 12). This is in line with the definitions presented by such writers as Leonenko (1995).

In his article, Chausov lists a number of components that can be used as a basis for planning the use of reflexive control. According to Chausov, the following is required for the planning of reflexive control:

− a goal-oriented process describing all the reflexive control measures required in the operation;
− a sufficiently comprehensive situational assessment of the intellectual potential of the commanders and their staff officers, allowing the implementation of the plans;
− conformity of the goals, missions, place, time, and methods for reflexive control;
− anticipation or modelling describing the situation of both parties at the moment reflexive control is applied;
− anticipation of situations on the basis of which reflexive control can be applied at an early stage, and as soon as the situation permits
(Chausov, 1999, pp. 12–13).

In his article, Chausov also discusses the way in which the flow of information between the enemy commander, command system and staff relates to reflexive control. In his view, the system of reflexive control is placed in the enemy's command system

in parallel to the system conveying the orders. Thus, all messages conveyed to the commander by his staff pass through the system of reflexive control, distorting them in the desired manner. When this model developed by Chausov is compared with the command and control model detailed in this study, it can be noted that exerting influence on the commander is also the most effective tool in Chausov's model (Chausov, 1999, p. 15). Chausov's ideas also have similarities with the dual control model described in the next subchapter.

However, the theory of reflexive control has also aroused criticism in Russia. An article by Polenin was published in 2000 in response to the article referred to above. In his article, Polenin who has extensively studied Lefebvre's theories, criticises Chausov for presenting reflexivity as an all-encompassing activity. In his view, the original idea of reflexive control as an instrument to control the adversary using desired information is misunderstood in this approach. In general, Polenin considers the reflexive control model too abstract and theoretical for practical applications. In his view, modelling the enemy's intentions is ultimately a subjective process, and guesswork and using it as a basis for decision-making is not without risks (Polenin, 2000, p. 68). However, Polenin is alone in his criticism. No other similarly critical articles have appeared, and in general, modelling the adversary's decision-making is considered entirely possible.

The article by Ermak and Raskin, published in the journal 'Armeyskiy Sbornik' in 2002, examines reflexive control from a new perspective. They discuss the use of simulations in the modelling of reflexive control. The article relates to the decision support systems discussed above. In their view, reflexive control can be used in combination with an automated decision support system, allowing the party applying reflexion to identify the situation, locate it in a database, and produce proposals for deploying troops in the situation (Ermak & Raskin, 2002, p. 46). According to Ermak and Raskin, this should be followed by the selection of the simulation-produced option that provides one's own side with the greatest advantage. In their view, this calls for creativity on the part of the commander and his staff. At the same time, Ermak and Raskin also emphasise that exerting reflexive control over the enemy is only possible if warfare is examined as a holistic struggle between systems (Ermak & Raskin, 2002, p. 46).

The article, published in the journal 'Reflexive Processes and Control' in 2003, can be considered a practical example of the anticipation, simulation, and comprehensive planning discussed by Chausov and Ermak & Raskin in their writing. Contributors to the publication included Lefebvre and a number of Western researchers. The article is aptly titled: 'From Prediction to Reflexive Control'. According to the authors, in traditional decision-making theories, the adversary is considered an uncontrolled factor, which naturally leads to the paradigm of anticipation. This means that a decision-maker attempts to anticipate the potential responses of the other side in different situations. Correspondingly, by applying reflexive control, anticipation can be replaced by defining the future. The authors introduce a new term, *reflexive decision*, in referring to decisions that contain an informational message for the other side (Lefebvre, Kramer, Kaiser, Davidson, & Schmidt, 2003, p. 86).

The authors present two potential operating models for reflexive control: *model 1*, in which the party applying reflexive control has one feasible option and tries to induce the adversary into a situation corresponding to this option; and *model 2*, in which the party applying reflexive control can rely on a limited number of 'tricks' but a large number of potential options. According to the authors, the Gulf War is an example of the application of model 1: coalition forces exploited the personal preferences of Saddam Hussein to lure his troops into the right positions to carry out a flank operation. The tactics used by the British Eighth Army in El Alamein is given as an example of model 2: the Germans were fed false information as a basis for their action, but they made the decision to use it (Lefebvre et al., 2003, pp. 87–90). This duality of models has similarities with the division into cognitive and informational models presented by Lefebvre in 1984. In the first model, the aim is to influence the known cognitive dissonance of the adversary (cf. Kahneman, 2003, p. 707), while in the second model, the enemy is provided with selective information.

It is important to note that in the authors' view the adversary is not only an individual but a community that has access to strategic and tactical information to support its decision-making, that is able to assess the challenges and risks involved in different actions and that is capable of modelling the potential countermeasures of the other side. The adversary may also review the same situation several times using different parameters, which will produce statistical information on the success of the action. Moreover, the adversary is expected to act in a rational manner or use methods that have the potential of bringing the best results (Lefebvre et al., 2003, p. 94).

The authors note that success can only be achieved if the other side is unaware that reflexive control is being applied. However, they point out that the party applying reflexive control can also prepare for this by producing cost-efficiency models that, even when turned on their head, do not put the actors in an inferior position. The authors also add that reflexive control has clear similarities with Shannon's information theory concerning the information that the opposing parties can expect to collect on each other (Lefebvre et al., 2003, pp. 99–101).

An article by Karankevich in the journal 'Voennaya Mysl' is related to the operating model presented above. In the article titled 'How to Learn to Deceive the Enemy' he emphasises the role of deception, listing a number of factors to support this view. Karankevich also includes the reflexive control of the enemy commander in these factors. According to Karankevich, the purpose of such control is to ensure that the decisions made by the decision-makers on the other side are, at least to some extent, more advantageous to one's own troops than to the enemy. He continues by noting that this is not possible by relying on a mixed bag of measures prepared in a hurry (Karankevich, 2006, pp. 142–143).

According to Karankevich, success requires a systemic approach in which, parallel to the actual operational plan, a diversion plan is prepared on the basis of which appropriate diversionary moves can be carried out (cf. the model of Kazakov & Kiryushin presented in Chapter 4.6). In that case, the commander must determine in advance which of the enemy's decisions are advantageous to his own side. Karankevich also discusses the use of information technology, which in his view, is connected with the use of reflexive control. He does not only emphasise the role of deceiving the enemy

but also highlights the extreme complexity of carrying out deception operations in today's situation. In his view, deception lies at the core of information operations and deception measures must be planned at strategic level (Karankevich, 2006, p. 143). There are clear similarities between Karankevich's thoughts and Lefebvre's approach to modelling the information available to the enemy and shaping it in accordance with one's interests (discussed earlier).

The articles described above indicate that in the Russo-Georgian war in 2008, Russia was able to use fairly sophisticated methods to model reflexive control directed at the adversary's decision-making and to exert such control. For example, according to Berger, the official Russian media portrayed Georgians as victims of reflexive control exerted by NATO and Western countries. However, it can also be asked whether this was the official Russian projection on what the Russians themselves consider essential (Berger, 2010, p. 143). In his own study, Berger also suggests that the aim of the reflexive control applied by Russia may have been to provoke Georgia to a conflict (ibid., p. 136).

In the articles written in the aftermath of the Georgian war (in 2010 and 2011), Chausov also discussed the lessons learned from the conflict (In Russia, the war is known as the South Ossetian conflict and Chausov also uses this term).

The first of these articles appeared in the journal 'Morskoi Sbornik' in 2010. Chausov first presents three problems of modern warfare that in his view, can be solved by applying reflexive control. He repeats his views that he had already discussed in an article in 1999 and in a book in 2008 and that are similar to those presented by Lefebvre in the 1960s (Chausov, 2010, p. 26). In his opinion, global perspective and the diversity of armed combat are at the core of modern reflexivity in the military context.

According to Chausov, the methods of reflexive control should be integrated at strategic, operational and tactical level on the basis of theories developed in earlier research. He notes that even though military commanders have always tried to influence the enemy's behaviour, exerting reflexive control has only been a part of this process in the most recent conflicts. He uses the 2003 war in Iraq as an example, noting that the coalition fighting in that conflict used psychological operations and conventional weapons that were more accurate and effective than those deployed in the past (Chausov, 2010, p. 28).

According to Chausov, the pervasive nature of information technology, especially in command and control systems, is a factor facilitating the use of reflexive control. This allows one's own side to infiltrate the enemy's information networks, filter information, block or restrict network access, set up 'information ambushes' and traps, distort information or replace information with lies. The capacity to create value-based models of the way in which enemy leaders behave is especially important. These models are compilations of behaviour, thoughts and emotions. Such activities can be carried out by broadcasting fabricated (but correctly presented) information directed against military and political leadership. At the same time, high-ranking officials are urged to betray their own country. This helps to create public support for one's own cause and weaken the adversary's will to fight. Chausov uses the war in Iraq and the

2008 conflict between Georgia and South Ossetia (sic) as examples (Chausov, 2010, pp. 27–28).

In his view, these factors do not only strengthen the role of reflexive control over the enemy in a successful military campaign but they are also an example of the complexity of such operations in today's conditions. Reflexive control methods should be coordinated and be in the right proportion to the goals, tasks, time and actions. First, it should be analysed how to act against the enemy's intellectual resources because modern technologies are not necessarily a prerequisite for success. A technologically inferior party may find ways to seize the initiative and, using determination, it may be able to impose its will on the enemy (ibid., p. 29).

Chausov discusses in his article how one can achieve success in such situations. Repeating his earlier ideas, he notes that it requires a comprehensive systemic approach in which, parallel to planning one's own combat operations, a plan for the enemy is also prepared. The plan for the enemy should include reflexive control actions helping to anticipate the enemy's decision-making. In this, Chausov agrees with Karankevich (2006) and Kazakov & Kiryushin (2013) whose views are discussed later in this study. According to Chausov, the thoughts of the commander and influencing them are at the core of today's military conflicts. This means that success requires reflexive analysis of the enemy's actions so that the background factors guiding them can be determined. Chausov attaches great important to using this method in an information environment. The key is to disrupt the enemy's actions using intellectual resources and combat operations based on information and information technology. In such situations, reflexive technologies are used to exert control over the enemy's operations rather than on its troops (Chausov, 2010, p. 29).

Chausov notes that the assumption in the process behind decision-making is that the enemy, too, relies on a complex and reflexive decision-making process, which requires the modelling and understanding of the way in which decisions are made on the other side. In that case, future events can be anticipated and the choices weighed by the adversary can be compared against the potential rational options available to one's own troops. In such situations, reflexive control comprises two cognitive sectors: structural details of the enemy's plan and information on to what extent the enemy is familiar with one's own plans. These two sectors provide the basis for how one should plan the action from the perspective of one's own troops (Chausov, 2010, pp. 31–32). These cognitive sectors are similar to the offensive and defensive information warfare discussed by Komov (1997) and Lefebvre's thoughts of knowing the enemy's plans (Lefebvre, 1967).

In his article, Chausov presents a model for preparing a plan against an enemy that takes into account reflexive control functions. He adds that exerting control over the enemy cannot merely be based on the commander's intuition. It cannot simply be based on coincidence, favourable terrain or weather conditions or on exploiting the errors made by the enemy (Chausov 2010, pp. 30–32).

In an article published in 2011, Chausov continues on the same theme, stating that a technologically inferior party may find ways to seize the initiative and impose its own will on the enemy. The first of these methods is to shift the focus of the conflict from

a confrontation between battle systems towards intellectual-informational confrontation. The second method is to apply reflexive control (Chausov, 2011, p. 30–31). The parties of a military conflict are complex, dynamic and mutually dependent battle systems. In addition to being hierarchically and vertically structured, they also have horizontal features. They have the purpose of the activities, information and in particular the commander's will as common features. Chausov notes that in modern warfare, thoughts are the key weapon and a crucial factor. For this reason, control can exerted more effectively by enhancing the intellectual potential of the commanders and other officers (ibid, p. 32).

Chausov concludes that the key to exerting control in a military confrontation is to force the adversary to apply methods and forms that are to the advantage of the controlling party. The thoughts of the commander and influencing them play the main role. As a result, achieving success requires reflexive analysis of information originating from both sides during the conflict (synthesis of information, thought and action). Using this approach, the factors behind developments can be determined and the correct line of action selected (Chausov, 2011, p. 34).

The conclusion from the above articles is that theoretical development of the control based on reflexion between systems continued in Russia during the first two decades of the 2000s and at the same time, efforts were also made to use it in military operations. This development phase was also characterised by the expansion of the reflexive perspective from cybernetics and psychology to nearly all fields of science (Semenov, 2017) and, in connection with this, the work carried out by such researchers as Lefebvre, Lepsky, Novikov and Thomas in the United States and Russia. With these developments, in Russia, reflexivity became a concept that is associated with such areas as personnel management (Giles, Seaboyer & Sherr, 2018, p. 5). At the same time, reflexive control assumed new forms, especially when it was connected with the opportunities arising from information operations.

2.6.6 Latest theoretical discussion and use of reflexive control

The latest phase of reflexive control is considered to have started after 2010. In those years, drawing on the lessons from the war in Georgia, Russia began to enhance the performance of its armed forces and to build new military capabilities. Moreover, in 2010, Russia announced a new military doctrine, in which NATO was openly named as a potential adversary (Lalu, 2014, pp. 350–354). The period of decline was now over.

Contrary to what is suggested in a number of studies (such as Giles, Seaboyer & Sherr, 2018, p. 4), the concept of reflexive control was still discussed in Russian military journals and other public forums and attempts were made to redefine its practical applications in the 2010s. The concept of reflexive control also appears in wider contexts, as shown by the examples taken from children's literature and films used in the article on the topic in the Russian Wikipedia (Wikipedia.ru, 2019).

There are also new definitions for reflexion, such as the one listed in the brief encyclopaedia of information-psychological warfare published in 2011 (Veprintsev, Manoilo, Petrenko, Frolov, 2011). According to the model described by Veprintsev et al.,

reflexive control is firstly a skill used to manipulate individuals or groups of people and secondly a method for exercising social control. According to the authors, reflexive control is based on creating a psychological model of the adversary. The model can be used to produce informational stimuli that will lead to desirable reactions. In fact, in their own words, the authors base their approach on Jungian psychology (Veprintsev, et al., 2011, pp. 446–448). Similar explanations of reflexivity can also be found in other sources and the original references to cybernetics and systems theory have been deleted from most of them even though similar descriptions were used.

The articles discussing the current state of reflexive control in which the matter is examined from Lefebvre's cybernetic perspective have been selected for this study because with them, the theory can be examined from new and different aspects and they do not merely repeat the content of past articles. The first of these articles is titled 'Reflexive Processes in Military Art: The Historico-Gnoseological Aspect', written by Valery Makhnin. According to the journal 'Voennaya Mysl', Makhnin is one of the foremost authorities on operational skills and tactics in the Russian Air Force, and in his article, he discusses the history of reflexive control and uses examples from the past to illustrate reflexive functions. Makhnin also combines definitions presented in earlier theories with a new way of describing reflexive control, which is based on sending information packets or *simulacra*. The article by Makhnin is also used by Thomas (2015) when describing the use of reflexive control in Ukraine. The article originally appeared in the journal 'Information War' (Makhnin, 2012) and it was republished in a slightly shortened form and with a different title in the journal 'Voennaya Mysl' in Russian and English (Makhnin, 2013a, 2013b).

Makhnin first takes a look at the history of reflexion and finds its origins in the philosophy of Plato and Descartes. He then discusses the original ideas of Lefebvre, which have provided a basis for identifying reflexive processes of opposing battle systems and for describing human mind. According to Makhnin, such researchers as Ionov, Druzhnin and Kontorov have built on this work (Makhnin, 2013b, p. 32).

Makhnin presents earlier arguments listing the benefits of reflexivity and notes that including reflexive factors in the process has helped to create a new, anticipatory model for operational planning and decision-making. This reflexive approach makes use of reflexive methodology on the basis of which the techniques, instruments and phases using information and psychological influence are planned and put into effect. Like Chausov, Makhnin also notes that reflexive influence can be achieved through a battle system that operates in an information dimension, at cognitive level, at sociocultural level and physically. Makhnin continues by defining reflexive control over the adversary as action used to disrupt its capacity to exploit success, to force it to reject its original plan and to force it to make non-rational decisions. He also notes that when reflexive control operations are planned and implemented, there must also be countermeasures to protect one's own troops against them. (Makhnin, 2013b, p. 34).

Makhnin introduces a new concept to the theory of reflexive control. The concept, which he calls *simulacrum*, is comparable with the previously used 'information packet' but it is more extensively used as a philosophical concept to describe a copy or a representation that has developed a complicated or questionable relationship with its

origins (Tieteen termipankki, 2019). With simulacrum, Makhnin refers to a stimulus arising from simulated influence produced by a reflexive system. Based on these stimuli, the adversary's battle system produces decisions and provides the system exerting reflexive control with the understanding that it needs to achieve its own goals. Organisation of reflexive processes between battle systems manifests itself in the development and carrying out of measures (sending simulacra) that provide the controlled system with areas of interest, motivation and reasons as a result of which the controlled system makes decisions that are in the interests of the controlling system (Makhnin, 2013b, p. 34).

Makhnin describes how the reflexive process advances at all levels (strategic, operational and tactical) through specific phases. Firstly, the adversary produces observations of a situation using external information as a basis. This information can be freely shaped so that the image based on it produces the desired effect on the adversary's behaviour. Reflexive control over the adversary requires targeted actions that are carried out taking into account reflexive factors that impact the way in which the controlled target understands the situation. To achieve this, the decision-makers of the controlling system must come up with methods influencing the situational picture created by the controlled system and that help their own troops to achieve their goals (Makhnin, 2013b, p. 35).

According to Makhnin, the reflexive variation is a focused three-phase action: it comprises process inputs (desired real-world objects), modifying inputs in a desirable manner, and outputs (targets that are susceptible to reflexive influences). In accordance with this process, when a party wants to exert reflexive influence on its adversary at a specific moment, the inputs are subjected to a reflexive conversion and the resulting outputs exert influence on the adversary's action moments later (Makhnin, 2013b, p. 35).
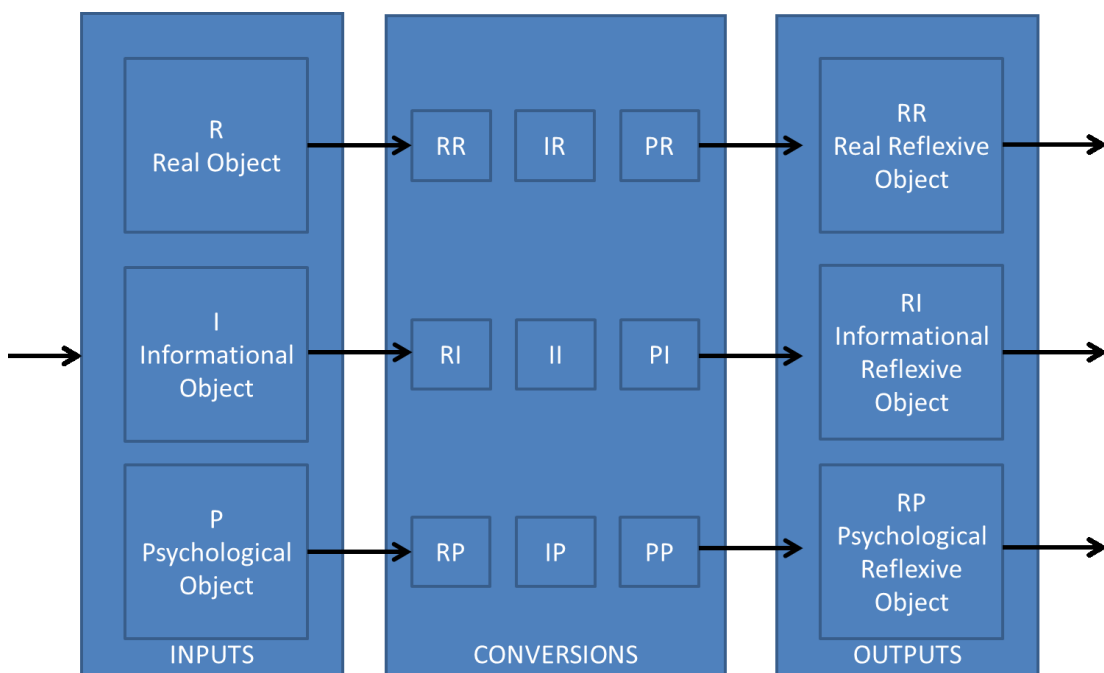

FIGURE 5: Reflexive conversion of inputs (Makhnin, 2012)

In accordance with the figure above, different ways of producing variations can be defined. Makhnin presents the variations of real-world objects, information world objects and variations of psychological impacts and the resulting categories of *simulacra*. By doing this, he expands the concept of reflexive control beyond the concept of information operations.

In his view, inputs can be converted into reflexive real-world objects in three ways. The first of them is the real reflexive object made of the real-world matter (shown as RR in the figure above). Laying of mines that impacts the adversary's decision-making is a concrete example of this. The second method is the real object made of an information world object and the third involves the generation of real-world objects using internal psychological models (Makhnin, 2013b, p. 35).

According to Makhnin, inputs can be converted into information world reflexive objects in two ways. The first of them involves converting a real-world object into information (RI). A photo or an infrared image of an enemy target is a concrete example of this. The second variation is the conversion of an information world object into information (II) (ibid, p. 36).

Inputs can also be converted into psychological reflexive influences in three ways. The first of them involves converting a real-world object into a psychological influence (shown as RP in the figure above). The second variation (IP) is the situation where information world objects or the information substitutes of real objects are converted into psychological influences. The final variation is the conversion of a psychological object into a psychological reflexion (PP). The workings of the commander's mind is an example of this (ibid., pp. 36–37).

According to Makhnin, the variations described above can be divided into two parts, one (RP, PR, IP and PP) comprising the variations in which humans play a role, and the other (RR, RI, IR and II) the variations in which human action is irrelevant. In Makhnin's view, by analysing past experiences and operational plans in which the aim had been to deceive the enemy, it can be noted that the reflexive influence over the adversary had been achieved in the above manner, using simulacra (false information perceived as true) (Makhnin, 2013b, p. 37).

In Makhnin's view, the key elements of reflexive influence are as follows: 1) the inputs creating the influence; 2) order of the inputs; and 3) the procedures used to create information packets. The fourth important thing is to identify the reflexive techniques used by the enemy and against which protective measures must be taken. Like Lefebvre et al., Makhnin also identifies two different principles for applying reflexive control (cf. Lefebvre et al., 2003): the first principle is to use predetermined simulacra so that the enemy can be induced to select the desired line of action. The second principle is to use simulacra with a vague chain of action. This means that the enemy uses the information as a basis for its own action and can choose between a number of different options. One must be able to shape one's own action on the basis of the option selected by the enemy (Makhnin, 2012, pp. 52–53).

Unlike earlier researchers, Makhnin is of the view that decision-makers do not need to be thoroughly familiar with the enemy's ideology, history or training methods when planning and exerting reflexive influence. In his opinion, military planners must find the weakest point in the enemy's battle system (cf. Leonenko, 1995) and strike at it so that the system collapses and forces the enemy to respond. According to Makhnin, reflexive actions are at their most effective when replacing rational stereotypic algorithms with entirely new methods and tactics and take the enemy by surprise. Likewise, reflexive actions can disorientate the adversary's command and control system by paralysing its components, one by one (Makhnin, 2013b, p. 43).

Like Lefebvre, Makhnin divides reflexive actions into creative and destructive categories. Creative reflexive actions can be used in slow-pace combat where the enemy's goals are known. In that case, the commander and his staff have time to analyse the situation and make conclusions of how it will develop. A plan that has been prepared well in advance can be revised if the situation is not developing as envisaged. In rapidly changing combat situations, quicker action is needed. In that case, the commander's decisions that are based on training and experiences, usually lead to destructive reflexive action (Makhnin, 2013b, p. 44). This division proposed by Makhnin has been used in combination with Lefebvre's similar model to create a reflexive control model for research purposes.

Makhnin's ideas were taken further by Kazakov and Kiryushin, and later also by Lazukin. The two articles of these authors from 2013 and 2014 discuss two-level control of combat operations in which the aim is to exert control over one's own troops and to develop capabilities to control the enemy at tactical level.

In their first article, published in the journal 'Voennaya Mysl', Kazakov and Kiryushin discuss the basis for action. The two suggest that there is a need to move from a reflexive theory to practice and to find realistic ways of applying the findings already made. In their own words, Kazakov and Kiryushin focus on how to control the enemy and apply two-level control in practice, or on whether it is possible to control troops that are not directly subordinated to the decision-maker (Kazakov & Kiryushin, 2013, p. 144).

The authors note that unlike in the civilian processes of reflexive control, in this case it is a question of exerting control over an enemy. Referring to existing research, they approach the subject by applying mission command to military engagement. Accordingly, the authors divide the concept of control into 1) mission command (mission based tactics directed at one's own troops; in Russian: командного управления); and 2) reflexive control (secret control exerted on enemy troops) and expand the perspectives of the articles and studies already published on the topic. The authors emphasise the differences between these two approaches to control in the execution of combat missions. Combining reflexive control and mission command enhances the effectiveness of the two-level control in which the aim is to manipulate one's own troops and control and direct enemy action. They call this reflexive superiority (Kazakov & Kiryushin, 2013, p. 145).

Combining Lefebvre's theory and the ideas of Makhnin described above, Kazakov and Kiryushin note that in Makhnin's view, key to reflexive control is the chance to generate influences preventing the enemy from using new information, to paralyse the enemy's creativity and to prevent the enemy from making full use of its combat potential (ibid., p. 146).

They note, however, that it is equally important for a researcher of reflexive control to identify the messages essential to reflexive control (the information packets used by the enemy as a basis for its decision-making). Like Makhnin, they recommend that the term 'simulacrum' should be used. In their view, it provides an adequate theoretical basis for the information packets used for deceptive purposes. They note that such information packets should be divided into two general models: representational and non-representational. A representational information packet is a copy of a copy (pretending to be the real thing). In the context of reflexive control, such information packets are used when one wants to conceal one's intentions. The information is partially false but its sole purpose is to conceal the real information and to deceive the enemy (Kazakov & Kiryushin, 2013, p. 146).

A non-representational information packet, on the other hand, does not pretend to be a copy of a real thing. Its purpose is to act as a cover for the original matter and to convey false information about a matter, action or an event. According to Kazakov and Kiryushin, these two content-based information models are the two sides of reflexive control, which they use as a basis for reflexive interaction in their own theoretical combat control model (ibid., p. 147). In their view, the concepts 'map' and 'doctrine' used by Lefebvre should also be reconsidered when used in a military context. The map is a description or a model of the objective reality of warfare. It may be subjective (inside the commander's head) or objective (on paper or as a computer file). Kazakov and Kiryushin approach the concept of doctrine (which, in addition to Lefebvre, has also been used by a number of other researchers of reflexive control) as an algorithm providing solutions for reflexive superiority. Their doctrine also contains 'filters', which were already used as research concepts between the 1960s and 1990s and which are used by a commander to separate relevant information from the irrelevant facts, wrong details from the right ones, etc. (Kazakov & Kiryushin, 2013, p. 147).

According to the authors, understanding doctrine (filters) helps to identify the methods, techniques and options that the troops can use to execute their tasks. In their own words, their aim is to prepare practical instructions and they also note that decision-making in general and preparing battlefield plans in particular are areas where mission command and reflexive control can be effectively combined. Both elements of two-level control can be used separately but coherence between them is needed so that effective two-level control actions can be carried out. Kazakov and Kiryushin note that if the above is accepted, an effective algorithm for decision-making can be created and it can be incorporated into rules of procedure (Kazakov & Kiryushin, 2013, p. 148).

Kazakov, Kiryushin with Lazukin continued on the same theme in another article, published in 'Voennaya Mysl' in 2014. They note that in their previous article, they recommended that research should be expanded to include the two-level control in

which the control over one's own troops and the enemy's troops is combined using advanced technologies and reflexive control methodology. However, they add that the theory should be further developed before it can be applied to command and control (Kazakov, Kiryushin & Lazukin, 2014a, p. 136).

According to the authors, the focus in the currently used models is on concealing the preparation and execution of the tasks. This is no longer enough and there is a need for methods combining the mission command of one's own troops with reflexive control over the enemy. In their view, ways must be found to synchronise mission command and reflexive control because they have been created for different purposes. It is, however, essential to describe how the elements of reflexive control and mission command can be combined chronologically during planning and execution based on successive information packets (Kazakov, Kiryushin & Lazukin, 2014a, pp. 136–138).

In their view, both the elements of mission command and reflexive control actions should be created simultaneously after the missions have been assigned, when the basic idea behind the action is formulated. The preparations for both actions should also be launched at the same time. When the order of decision-making is already known, a similar operating model compatible with the model selected for decision-making should also be developed for the planning of reflexive control (ibid., pp. 137–139).

According to the authors, enough force should be allocated for mission command tasks and reflexive tasks at each phase of two-level control. A certain number of troops should be set aside for reflexive control operations, while combat troops can also be redeployed to execute reflexive control missions. According to Kazakov et al., timing should be a key priority:

- during the preparatory phase, the troops engaged in reflexive control should use the time between the assignment of combat missions and their execution to carry out pre-planned tasks to make the situation more advantageous to one's own side; the troops executing combat missions prepare their own actions themselves;
- during the combat missions, combat troops and troops engaged in reflexive control must launch their operations simultaneously (Kazakov, Kiryushin & Lazukin, 2014a, p. 139).
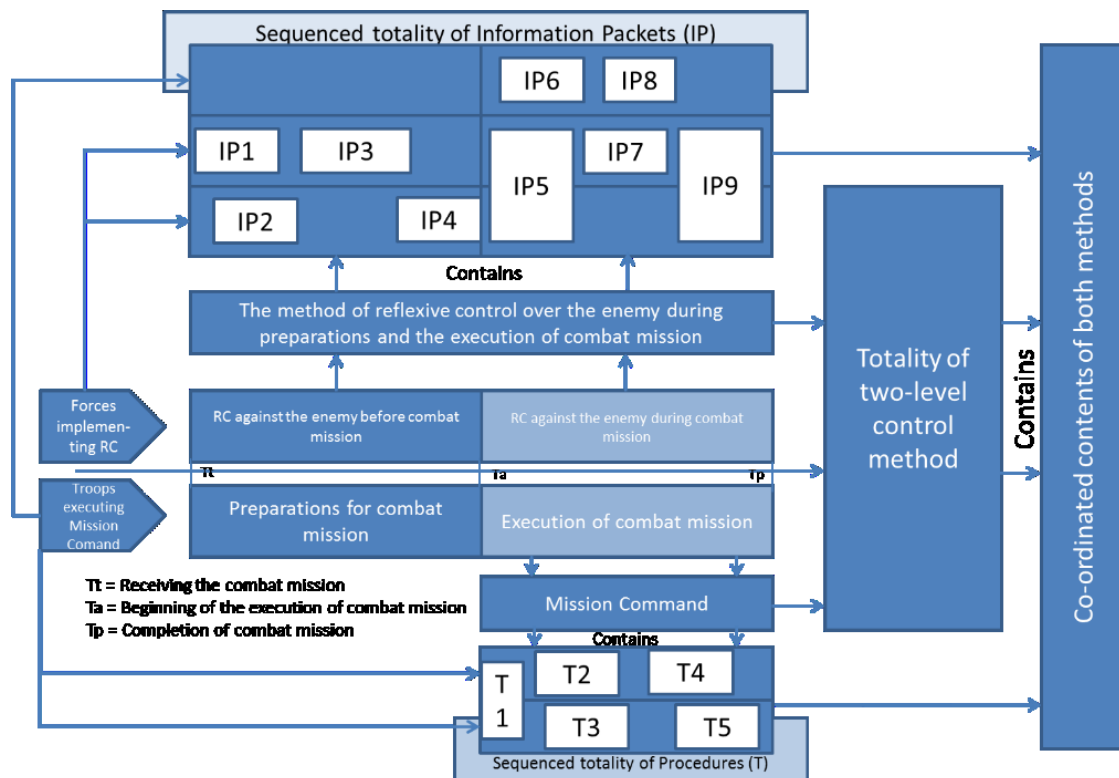
FIGURE 6: Chronological connection between reflexive control and mission command methods (Kazakov, Kiryushin & Lazukin, 2014b)

According to the authors, implementation of the procedure that helps to achieve reflexive control over the enemy starts with the sending of information packets (IP) to the enemy (cf. Lefebvre, 2003, p. 90; Makhnin, 2013). The information packets may be representational or non-representational simulacra prepared so that the enemy accepts them as inputs for its own system. These information packets are used as the main tool for reflexive control and they can be used as a basis for exerting reflexive control over the enemy (Kazakov, Kiryushin & Lazukin, 2014a, pp. 139–140).

According to Kazakov, Kiryushin and Lazukin, the method of exerting reflexive control over the enemy can be defined as the sequenced totality of the information packets that have been sent to the enemy to create conditions in which one's own troops can successfully execute their combat mission. They expand this definition by adding that each information packet describes an imaginary situation or attempts to conceal the real situation and the actions of one's own troops (Kazakov, Kiryushin & Lazukin, 2014a, p. 140).

It is essential to prepare an algorithm on the basis of which information packets are sent during combat missions to ensure that future missions can be carried out more effectively. In their article, Kazakov et al. have created a cyclical model for executing combat missions and the two-level control should be exerted in accordance with this model. It starts from the assignment of the combat mission and continues with a situational assessment, in which the commander uses his own experience in carrying out reflexive control in accordance with the plan prepared by higher-level commanders. At the same time, the commander starts developing his own method of reflexive

control and weighs the options of how to execute the combat mission. The totality of the model is described in the figure below.

Cycle of executing combat missions in the model of two-level control

Defining RC missions ensuring that the enemy will get the desired image of oneself (decomposing RC into methods

Defining the image of oneself in the eyes of the enemy (defining RC goals)

Informational reflexion (information in the possession of the enemy)

Cognitive reflexion (the decisions that the enemy may take at this stage)

The method of exerting control over the enemy (RC) during the preparations and execution of combat missions

Method of two-level control

Methods of mission command

Executing RC missions with the troops assigned for the purpose and execution of combat missions

Coordination of command and control methods

RC measures that have already been executed

Experiences of combat leadership

Situational assessment

Analysis of mission preparations and completed missions (generalisation and systematisation of experiences)
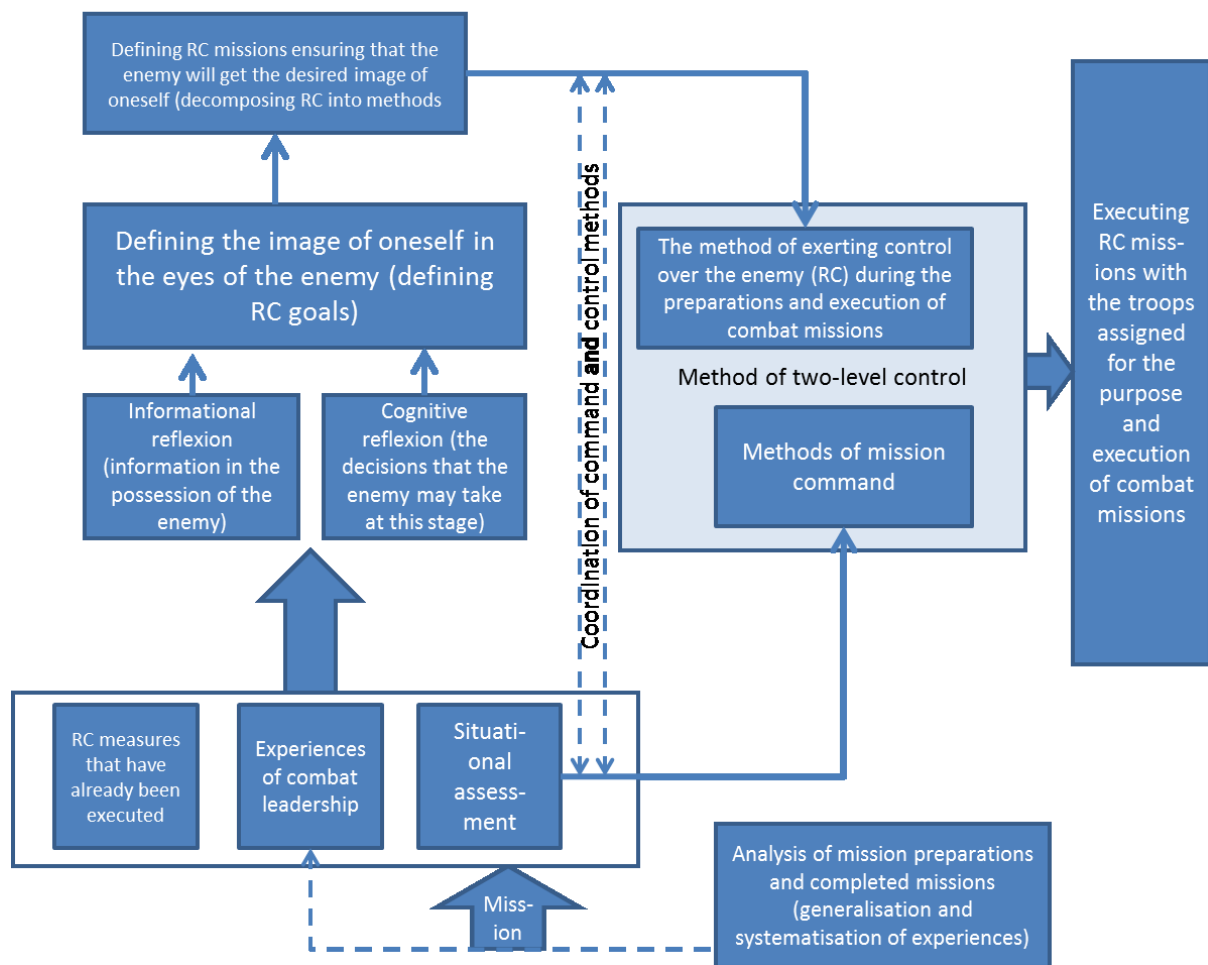
Mission

FIGURE 7: Cycle of two-level control (Kazakov, Kiryushin & Lazukin, 2014b)

All available information on the situation, including any changes during combat missions, should be reviewed by the commander in two different ways:

Firstly, by means of informational reflexion, in which the situational picture used by the enemy and possible enemy action are analysed. The purpose of this reflexion is to ascertain what the enemy knows about one's own forces and of their potential actions. This is done by analysing the reconnaissance methods used by the enemy, their capabilities and location, and to assess the capability of the enemy to process the information collected by it (Kazakov, Kiryushin & Lazukin, 2014a, p. 140).

Secondly, the commander should apply cognitive reflexion. This process produces an assessment of the criteria used by the enemy when making decisions and an assessment of the personal characteristics of the enemy commander behind this decision-making process. The cognitive dimension is a key factor in the decision-making process. It provides an instrument for analysing perceptions of the battlefield situation

and the elements behind decision-making (Kazakov, Kiryushin & Lazukin, 2014a, pp. 140–142).

On the basis of these two actions, the commander must be able to formulate a picture of how his forces are viewed by the enemy. He must work to prevent the enemy's responses to the action taken by his own troops. Using informational and cognitive reflexion, the commander creates an image of a specific situation and this image can be supplemented with computer simulations that visualise the situation and increase the number of individuals involved (Kazakov, Kiryushin & Lazukin, 2014a, p. 142).

In the next phase, the commander determines how the enemy can be provided with a favourable image of his forces by sending the enemy a specific number of information packets. Knowing the real situation and the state of his own forces and determining what should be conveyed to the enemy so that the mission can be executed, the commander sets out the goals for reflexive control. Following this, the commander compares the goal against the troop strength at his disposal and breaks down the goal into reflexive control tasks and determines their order of priority before and during the combat mission. The framework for carrying out the reflexive control missions is prepared in this manner. The commander assigns a troop contingent for each reflexive control mission and the task of these contingents is to send specific information packets in a specific order. Each of these missions must be carefully prepared and coordinated with the mission command method. This is how synchronisation between mission command method and reflexive control, process of specifying their details during the planning process and their joint implementation are given priority in the two-level control method. Each phase of the combat mission must be concluded with an analysis, in which the results of these two methods are reviewed and the results are used in the execution of next phases and missions (ibid., pp. 142–143).

Depending on the situation and the mission, the order of priority between these two methods may vary and it may be more advantageous to continue reflexive control at the expense of the control of the troop contingent engaged in battle. If the commander wants to enhance the effectiveness of reflexive control, he should have a military unit specialising in information and psychological warfare that is able to develop alternatives to reflexive control and combine them with his tactical decisions (Kazakov, Kiryushin & Lazukin, 2014a, p. 143). According to the authors, combat missions can be executed more effectively if there is a shift from concealment of actions to two-level control and measures are taken to establish coordination between the combat troops and the troops carrying out reflexive control tasks (Kazakov, Kiryushin & Lazukin, 2014a, p. 143).

Finally, the authors link their own theory with the articles in the journal 'Voennaya Mysl' already discussed in this study, concluding that the theory is flexible enough to tolerate many of the past inconsistencies. In fact, the text has a number of similarities with the ideas presented by Karankevich and Chausov but Kazakov et al. present them in a clearer and a more practical form.

In an interesting side note in the debate on reflexive control, Alexandr Raskin, a senior officer in the Russian Air Defence Troops, published an article in 2015, in which he discusses reflexive control in social networks and the social media. Raskin's ideas can

be compared with the sending of information packets discussed above. According to Raskin, instruments such as social media allow detailed information to be collected on individuals and this information can be used to steer their behaviour. Using social media, public opinion can be changed in a manner that forces the military-political leadership of the countries concerned to react. At the same time, people's opinions can be influenced so that the leadership comes across as incompetent. Such operations can reduce the influence of military-political leadership and disrupt the work of public authorities (Raskin, 2015, pp. 15–16).

According to Raskin, reflexive control through social networks is particularly well-suited for this purpose. In that case, the aim is to construct information packets tailored to each individual user that can be built into coordinated structures exerting significant influence on the enemy's decision-making. Social networks can be used to influence individuals' behaviour and their beliefs and such action provides a basis for the use of legal 'agents'. Raskin continues by noting that the act on 'foreign agents' approved in Russia at the time when the article was published is necessary to ensure that this type of reflexive control can be prevented (Raskin, 2015, pp. 16–17). Raskin's views are in line with the plans to prohibit Russian soldiers from publishing material in the social media or from using smart devices while on duty (Roth, 2019). It seems that the theoretical work carried out in Russia has brought home to the country's leadership that in addition to sending images and geographic data, these social networks can also serve as instruments influencing soldiers' thinking.

It can be concluded from recent developments that Russia is working to build methods to exert reflexive control over the enemy during combat missions. The model presented by Kazakov, Kiryushin and Lazukin combines reflexive control and mission command into an instrument to achieve the same goals and to coordinate the use of troops. When this is combined with Makhnin's approach to reflexive control as a comprehensive action, in which every information packet sent to the enemy is analysed from reflexive perspective, the end result is a comprehensive theory of exerting influence over the enemy. In retrospect, it can be said that Russia has operated in the social media more or less in the way described by Raskin in his article. Attempts to influence elections is one example of this but similar activities have also taken place as part of information operations during military campaigns in such places as the Crimea. Prohibiting soldiers from sharing information in the social media may also be related to this.

3. APPLICATION

3.1 Model of reflexive control

A variety of definitions for reflexive control have already been presented in this study. Lefebvre himself noted in 2010 that reflexive control is based on a mathematical model comprising the actors involved, relationships between the actors and the options available to the actors in their decision-making, producing a reflexive equation, which, when solved, specifies the areas where reflexive control is feasible and where it produces the best results (Lefebvre, 2010, pp. 82–94).

To complement this definition, a model has been prepared on the basis of the sources discussing reflexive control and presented above. It encompasses all aspects of reflexive control, from the methods of exercising it to its goals, using the division *Ends-Ways-Means* produced for strategy by Lykke (Lykke, 1989). The essential feature of the model is that, in accordance with the ideas presented by Lefebvre (1984b) and Makhnin (2012), it is divided into two implementations: constructive (creative) implementation, employing procedures aimed at inducing the enemy to make desired decisions, and the destructive implementation, employing methods attempting to weaken and disrupt the enemy's decision-making (*Ways*). The model also features different types of reflexive control (Lefebvre, 1984b; Lefebvre et al., 2003; Makhnin, 2012), different forms of control inputs (Makhnin, 2012) and different methods for exerting reflexive control (*Means*). The model combines all these factors to illustrate the areas of the military command system targeted for the influencing efforts (*Ends*).

The focus in the model is on those characteristics that are exploited to exert control over the enemy (not over one's own troops or citizens) and no reflexive equations of the methods are constructed in the model. This is based on the idea that the party applying reflexive control tries to be part of a second-order cybernetic system that exerts control over the target system and its decision-makers in accordance with a plan prepared in advance. The model is presented in three separate tables, the first of which contains an assessment of the constructive methods, and the second one an assessment of the destructive methods. The third table gives estimates of the desired impacts on different targets.

TABLE 1: Methods and targets – constructive/creative method

				REFLEXIVE CONTROL MODEL CLASSIFIED BY IMPLEMENTATION, TYPE, INPUTS, METHODS AND TARGETS					
					TARGETS				
Implementation of Reflexive Control (Lefebvre, 1984b; Makhnin 2012)	Type or model of reflexive control (Lefebvre, 1984b; Lefebvre et al., 2003; Makhnin, 2012)	Reflexive control inputs (Makhnin, 2012)	Reflexive control methods (source)	Personal characteristics and behaviour of the commander	Plans prepared by the commander and staff	Decision support systems	Command and control system	Operational environment	
Constructive / Creative	Informational (IO)	Real (RE)	Pressure and threats (show of force) (1, 3, 5, 6)	X				X	
			Provocations, troop movements and action (3, 6, 9)	X				X	
		Information(I)	Persuasion, suggestion and pacification (5, 6)	X		X		X	
			Transferring the decision-making goals, motives or grounds to the controlled system (3, 9)			X			
			Taking advantage of bilateral contacts between two parties (3)	X					
	Cognitive (CG)	Psychological (P)	Determining areas of interest and factors and reasons behind the interest (4, 5, 7, 8, 9)	X				X	

SOURCES:

1) Ionov, 1971
2) Druzhin & Kontorov, 1976
3) Reid, 1987
4) Leonenko, 1995
5) Ionov, 1995a
6) Komov, 1997
7) Karankevits, 2006
8) Chausov, 2010
9) Makhnin, 2012
10) Kazakov, Kirjushin & Lazukin, 2014

TABLE 2: Methods and targets – destructive method

REFLEXIVE CONTROL MODEL CLASSIFIED BY IMPLEMENTATION, TYPE, INPUTS, METHODS AND TARGETS

Implementation of Reflexive Control (Lefebvre, 1984b, Makhnin 2012)	Type or model of reflexive control (Lefebvre, 1984b; Lefebvre et al., 2003; Makhnin, 2012)	Reflexive control inputs (Makhnin, 2012)	Reflexive control methods (source)	TARGETS				
				Personal characteristics and behaviour of the commander	Plans prepared by the commander and staff	Decision support systems	Command and control system	Operational environment
Destructive	Informational (IO)	Real (RE)	Deceiving the enemy's reconnaissance systems by means of decoys and disguise (1, 2, 3, 4, 5, 7)		X	X		X
			Striking at command posts and commanders (5)		X	X	X	
			Forcing the enemy to react at the right moment or taking action to wear down the enemy (1, 5)	X	X			
		Information (I)	Intimidation, sowing uncertainty, ruthlessness and mercy (3, 5)	X	X		X	
			Discrediting the enemy using forged or distorted information (5, 8)	X				X
			Using disinformation and controlled leaks to influence the enemy's understanding of the situation and the way in which it forms its SA (1, 2, 3, 5, 10)	X		X		
			Overloading the enemy's decision-making mechanisms with information, actions, doctrine or readiness (1, 5, 9, 10)	X	X	X	X	
			Controlling the information sent by one's own troops or restricting the enemy's access to information (5, 8, 9, 10)	X	X	X	X	
	Cognitive (CG)	Real (RE)	Building coalitions and attracting traitors (3, 5, 8)		X			X
			Surprise attacks and using the element of surprise (1, 5)		X			X
		Information (I)	Exploiting the known doctrine of the enemy or the enemy's attempts to exert reflexive control or simulating past conflicts (3, 5)	X	X	X	X	X

SOURCES:

1) Ionov, 1971
2) Druzhin & Kontorov, 1976
3) Reid, 1987
4) Leonenko, 1995
5) Ionov, 1995a
6) Komov, 1997
7) Karankevits, 2006
8) Chausov, 2010
9) Makhnin, 2012
10) Kazakov, Kirjushin & Lazukin, 2014

The model described above shows that the implementation making use of constructive reflexive control can be based on any of the three inputs. The real inputs are based on the action of one's own troops, while the informational and psychological inputs are based on the starting point or situational data created for the enemy's decision-makers that is advantageous to one's own side. Using these inputs as a basis, the enemy is expected to voluntarily make decisions that are advantageous to one's own side and that one's own side has been able to anticipate. Destructive reflexive control can be applied using real and information inputs that mainly comprise surprise/deception by one's own troops or the feeding of information to the enemy's system and decision-makers that creates confusion on the enemy side or is otherwise harmful to the enemy. These inputs are expected to destroy, weaken or paralyse the enemy's decision-making capacity.

The implementation based on constructive reflexive control usually require more time than the implementation of destructive reflexive control. As noted by Makhnin, it is better suited for long-term use at higher strategic level. Actions paralysing or destroying the enemy's decision-making capacity resembles traditional information or psychological warfare that can be launched at short notice and at lower tactical level.

It can also be noted from the tables that under the division cognitive/informational, most of the methods referred to in the sources are of informational type. This is probably because exploiting the cognitive dissonance of the enemy requires considerably more information about the enemy so that it is easier to feed selected information and allow the enemy to react to it in its own way and adjust one's own action after that. It can be noted that constructive control is mostly directed at the commander's personal characteristics and his operating environment. The methods applied in destructive control are equally directed at all areas of command and control. When the targets grouped by goal are examined, it can be noted that in most of the sources used, the aim is to change the personality and behaviour of the commander or to interfere with his decision-making. The lowest number of references were made to influencing the command system. This is in line with the ideas already put forward by Ionov (1997) in whose view influencing the enemy's situational understanding and goals is the easiest part, while exerting influence on the actions themselves is more difficult.

When examining the constructive/destructive division, it can be noted that the constructive approach contains significantly more influences and influences that are more advantageous to the controlling party, especially when the activities are directed at the commander, plans prepared by the commander and his staff or decision support systems. At the same time, however, most of the goals directed at the command system and the operating environment are destructive by nature. This is in line with the observation concerning the time available (already discussed above): constructive implementation requires better understanding of the adversary and the factors behind its behaviour. When successfully applied, these methods generate considerable advantages to the controlling party. The methods directed at the command system and the operating environment can put into use at short notice but their effects are of shorter duration and must be exploited quickly.

TABLE 3: Goals of reflexive control (by target)

Targets

Goals	Personal characteristics and behaviour of the commander (1,2,3,4,5,6,7,9,10,11,12)		Plans prepared by the commander and staff (1,3,4,5,7,8,9,11)		Decision support systems (1,2,4,5,6,9,11,12,13)	
	Constructive: Changing the commander's thoughts, behaviour and will, exploiting personal characteristics, determining personal 'filters', influencing the selection of goals	**Destructive:** Transferring the desired decision, lowering the readiness level, putting pressure on the commander, paralysing creativity	**Constructive:** Determining the options available to the enemy and its algorithm, determining the goals, state of troops and organisation, managing situational understanding, creating 'goals' for the enemy's plans, determining the enemy's plans, sending correct stimuli	**Destructive:** Creating threats against the enemy's plan	**Constructive:** Influencing the situational awareness of the enemy, influencing the situational assessment of the enemy, controlling the information collected by the systems, filtering information and replacing it with one's own information, assessing the enemy's reconnaissance capabilities	**Destructive:** Preventing the enemy from using new information

Goals	Command and control system (6,9,11)		Operational environment (2,4,6,10)		Sources:	
	Constructive: Influencing the decision-making algorithm	**Destructive:** Distorting the information conveyed through the command system, causing disorganisation in the system	**Constructive:** Influencing public opinion	**Destructive:** Influencing the timing of decision-making, 'associating' the enemy with past conflicts, discrediting decision-makers and arousing suspicions	1) Lefebvre 1968 2) Ionov, 1971 3) Druzhin & Kontorov, 1976 4) Reid, 1987 5) Leonenko, 1995 6) Ionov, 1995a	7) Komov, 1997 8) Karankevits, 2006 9) Chausov, 2010 10) Chausov, 2011 11) Makhnin, 2012 12) Kazakov, Kirjushin & Lazukin 2014 13) Lefebvre et al. 2003

3.2 Examination of Russian debate on RC

A number of reflexive control dimensions have been omitted from the above model. One of them is the applicability of the theory at different operational levels (from tactical to geopolitical). There is little discussion in the original sources on the operational levels where reflexive control should be used. For example, Lefebvre only makes generic references to 'decision-makers'. The other writers active in the 1970s (such as Ionov) are equally vague. In fact, the operational level only became a topic of discussion in the 1980s. This was prompted by American researchers who noted that reflexive control is a useful tool at strategic level and that the Soviet orientation is systemic-strategic compared with the technical-tactical approach favoured in the United States (Chotikul, 1986, p. 35).

According to this study, there were few references to operational levels in the Russian debate on reflexive control before the 2010s (Chausov, 2010). Makhnin notes, however, that reflexive control is based on the same operating model at all levels (Makhnin, 2013a, p. 35), which means that the discussion has remained more or less along the same lines over the past few decades. In his book 'Kremlin Kontrol', Thomas notes that reflexive control can be applied at tactical, operational, strategic and geopolitical level (Thomas, 2017, p. 178). In fact, for the people behind the theory of reflexive control and for those responsible for its practical applications, the issue of operational levels has not been a prime concern. In their view, it should be applicable at all levels listed by Thomas when used in combination with different methods. The activities should be directed at the adversary's decision-makers regardless of whether they are heads of state, Members of Parliament or battalion commanders.

The second dimension examined in this study is the objective and comprehensive modelling of human decision-making, which is also the key prerequisite for the successful application of reflexive control. This is because the whole concept is based on the assumption that the enemy's decision-making can be modelled so that using specific preprepared inputs, the enemy can be persuaded to take the decisions anticipated and desired by the other side. If this philosophy discounting individual actors' will to act independently of the world around them had been questioned in Russia at some point, reflexive control had been deemed basically non-feasible and it would probably have been rejected. However, this did not happen, not even when the Soviet Union disintegrated.

With the dissolution of the Soviet Union, the rest of the society abandoned dialectical materialism and the Marxist theory, at least officially. However, in the Russian armed forces, this same philosophy continued to set the tone for the debate. Even though the purpose of this study is not to find answers to the question why this happened, it has become clear during the preparation of this report that the collapse of the Soviet Union and the defeat in the struggle between ideologies triggered surprisingly little debate in Russian military journals. The ability of dialectics or the systems theory to model reality has not been challenged at any point (cf. Lalu, 2014, p. 368). The assumptions that all world events are objectively true and dialectically connected to each other (and thus reflected in human mind) did not disappear with the collapse of the Soviet Union and its ideology. This also explains why reflexive control is not questioned and the few critics of the theory do not challenge dialectics as such but the

feasibility of the ways in which it is implemented (Polenin, 2000, p. 68). This may also explain why the development of reflexive control has continued and the original philosophical assumptions have not been questioned.

The third dimension that should also be considered when a model based on open sources is used is the idea put forward by Klimenko that all open doctrines should contain normative descriptions and reflexive functions (Klimenko, 1997). This leaves open the possibility that some of the articles discussing reflexive control have been deliberately written so that the reader can be convinced of the existence of a specific method or that specific activities are carried out and shares information that is actually untrue. The author of this study has made every effort to avoid such manipulation by relying on a broad range of sources. It is difficult to imagine that all this could be based on vast censorship and coordination of articles that has allowed the Soviet Union and Russia to engage in systematic deception over a period of 50 years, especially when many of the writers are from the West or from other countries outside Russia. However, this possibility cannot be entirely discounted and the descriptions of the methods contained in the models should be treated with caution. This problem will be discussed in more detail below in connection with the reliability of research.

3.3 Role of information in Russian military strategy

As set out in the model presented in this study, conveying selected information to the adversary has been a key component of reflexive control since the concept was first presented by Lefebvre. However, reflexive warfare is not only information warfare but a comprehensive operating model, one form of which is information-psychological confrontation. In a speech to the Russia Academy of Military Science in 2013, Valery Gerasimov, Chief of the General Staff of the Russian Armed Forces, noted that information warfare continued throughout a conflict and it started long before the military action itself (Gerasimov, 2013). This speech has achieved a great deal of attention in connection with the occupation of the Crimea and the conflict in Ukraine. Indeed, selective information is a concept that often comes up in Russian military debate.

Ulrik Franke, a Swedish military researcher, has written a study of information warfare, which relies on Russian documents as source material. Like Makhnin, he highlights the use of real, informational, and psychological inputs in the conveying of information. According to Franke, the following measures can be used during peacetime: attempts can be made to discredit foreign politicians; messages can be sent by means of aggressive air operations; or Russian views on the world situation can be conveyed through suitable media (Franke, 2015, p. 51). However, as required in the implementation of reflexive control, more importance is attached to the adversary's interpretation of the activities than to the activities themselves.

The article by Bogdanov and Chekinov on the development of warfare also discusses information and helps in understanding its use as part of reflexive control. They list methods of warfare based on destructive reflexive control, in which information and telecommunications equipment, as well as computers, is used to paralyse the adversary's command systems and administration, disrupt the adversary's computer centres and communications networks, destroy military and political command centres, and

demoralise the adversary's troops and wider population (Bogdanov & Chekinov, 2017, p. 79).

One comment of the authors is interesting in the context of the information dimension of reflexive control: in their view, we must understand that conflicts are now also fought in the information battlefield, an entirely new theatre of war, which sets the scene for the struggle taking place in the human mind. Understanding this shows that despite technologies, humans and their moral-psychological characteristics remain a target of operations. Bogdanov and Chekinov go on to note that in all warfare, it is essential to destroy the minds and psyche of individuals capable of setting strategic goals. In their view, as information has become an accepted instrument of warfare, more tools and methods are now available to achieve this goal. Despite this, armed combat cannot be entirely supplanted, but it should be used on a more limited scale (Bogdanov & Chekinov, 2017, p. 79). Indeed, reflexive control combines the use of information and armed action in a single package.

Influencing cognition, an idea behind creative reflexive control methods, is discussed by Kiselyov in his 2017 article. His focus is on the future warfare for which the Russian armed forces should be prepared.

According to Kiselyov, in technologically advanced countries, cyberspace is seen as an operating theatre. It can be combined with other methods, the most important of which are electronic warfare, psychological operations, and kinetic effects against the enemy (the destructive methods of reflexive warfare). Confrontation at information level will be a crucial factor in future warfare, and it will largely manifest itself in information-controlled operations. These comprise actions intended to have the desired effect on the adversary's will, emotions, behaviour, psyche, and morale; in other words, they are methods considered to be creative control instruments in the system of reflexive control. According to Kiselyov, the goal in information warfare is to influence the adversary's decision-makers. Psychological operations, hacking, deception, electronic warfare, physical destruction of enemy equipment, the capture of the enemy's decision-makers, and network operations are some of the key methods and techniques used in such warfare (Kiselyov, 2017, p. 5). In other words, as set out in the reflexive control model, Kiselyov combines constructive and destructive methods, illustrating a system that is described in the dual model of reflexive control.

In Kiselyov's view, the focus should now be on warfare directed at behaviour. Such warfare has only become possible in recent years as methods have been developed to collect large amounts of data on human behaviour. Human behaviour is not only based on ideas, values, and beliefs, but it is also to some extent founded on stereotypes, habits, and behavioural models. At the same time, our behaviour is also shaped by official and unofficial institutions. Kiselyov goes on to note that there is indisputable scientific evidence that human behaviour largely takes place in semi-automatic mode and is based on habits and stereotypes (cf. Kahneman, 2011, pp. 20–21). In his view, this not only applies to simple solutions, but the effect also manifests itself in complex decision-making situations involving choices that require in-depth thinking (Kiselyov, 2017, p. 6).

Weapons influencing behaviour are the weapons of the future, and Kiselyov claims that Western countries, especially the United States, are already developing them. Kiselyov notes that it is particularly important to conceal the personal data of senior officers to ensure the adversary is unable to anticipate their decisions in conflict (Kiselyov, 2017, p. 7). In this, he indirectly admits that the Russian view is that such calculations can be made, as this is also set out in the theory of reflexive control.

Without referring to it by name, Kiselyov provides a comprehensive description of reflexive control in his article: he describes the asymmetric advantage that in his view can be achieved by concealing one's own preparations and military action, by seeking and exploiting weaknesses on the other side, by directing one's own forces at the adversary's weaknesses and by changing the adversary's view of the conflict in a manner that is advantageous to one's own side. Such measures cause only minimum attrition of resources on one's own side compared to what the adversary must endure, and they help to achieve military superiority or equality in a conflict (Kiselyov, 2017, pp. 10–11).

Indeed, information and information-based warfare have assumed an increasingly important role in Russian debate in recent years. In their articles, Bogdanov, Chekinov and Kiselyov emphasise the information impacts of real, informational and psychological inputs in the same way as Makhnin. Kiselyov also describes the efforts to create a pre-emptive model (as suggested by Kazakov & Kiryushin), in which the information inputs directed at the adversary are coordinated as part of the overall activities. On this basis, information warfare and reflexive control become overlapping concepts, but information is not the only instrument to achieve reflexive control. This is because reflexive control makes extensive use of cognitive dissonance and the understanding of human behaviour. It is essential to understand the process of sending information and the attempts to influence the adversary, and to protect one's own troops against the information operations carried out by the other side.

4. CONCLUSION

4.1 Systemic basis of Russian C2 theory

In the context of the fundamentals of cybernetics and systems theory, this study shows that since the 1950s, there have been determined efforts in the Soviet Union and Russia to develop cybernetics for modelling and creating military decision-making systems, and that this work has continued on a different basis than in the West. As early as the 1960s, attempts were made to develop a nationwide information network and highly automated control and management systems.

When the system of military decision-making was examined from systemic and cybernetic perspectives, it was noted that in Russia, the command system is examined in its totality. The aim is to outline all the components that have a direct or indirect impact on the area of study. In the systemic approach, the parts of a command system are outlined and studied as a dialectical entity of interactive elements.

When the expectations placed on military commanders and principles of warfare were studied, it was noted that, as in the Soviet Union, there is still a strong emphasis on unitary military leadership and the commander's role is emphasized in Russian military thinking. This is combined with a strong logical and mathematical chain of deduction and the ability to identify causal chains. It was noted that command and control have assumed a more important role since it has been realised, by trial and error, that success in military action at all levels depends on flexible application of command and control practices. However, unlike in the Western mission command approach, the focus in the Russian debate on military leadership is on the need of commanders to control their subordinates to ensure that any deviations from a plan can be identified at an early stage, and the operations can be redirected.

An important observation was made on the keen interest in Russia on decision support systems, and that intensive development work in this area is also underway. They will assume a more important role when efforts are made to implement a rapid and highly automated command system that can use the information available concerning the operating environment and produce analyses and recommendations. At the same time, protecting them against enemy action and their sensitivity to reflexive control have become a major concern.

The commander plays a key role in Russian decision-making. Indeed, one of the conclusions made in this study is that this at least partly explains why the focus in reflexive control is on the commander, his plans, and his personal characteristics. At the same time, it was also noted that the Russian commander-centric model is better suited to rapid and automated decision-making than the Western model, in which there is a greater need for human involvement, and coordination between individuals. It may also be more vulnerable to influencing attempts (such as reflexive control), as it involves fewer individuals whose observations of the environment should be shaped.

The objective approach is the key weakness of the Russian decision-making system in the context of decision-making theory. The idea of dialectical materialism is that all reality and awareness have an objective basis, and that all decisions are based on observations. This may restrict the use of intuition and creativity. However, the author was unable to find any signs of this at the practical level.

4.2 The development of Reflexive Control

The main conclusion drawn from the assumptions behind reflexive control was that because of historic and social factors, command and control plays a key role in Russia (as was already the case in the Soviet Union). However, these factors were not systematised before the 1960s, and they were only used intuitively and subconsciously. This study notes that in dialectical thinking based on Marxist philosophy, human awareness is simply a reflection of objective reality. This may create a situation in which reflexive control only needs to use external stimuli to steer the manner in which the target perceives its environment.

Vladimir Lefebvre, the man behind the reflexive control theory, attempted to develop reflexive equations to model the adversary's decision-making process and discussed that they could be used to calculate the options available to the adversary. In Lefebvre's studies from the 1960's this creates a situation where the other party to the conflict can gain an advantage if it knows the adversary's situational assessment and is aware how the adversary applies its own doctrine to solving the problem. This becomes the core of reflexive control.

The research Lefebvre started continued in the Soviet Union on a broad front. It is suggested in the study that the bidirectional nature of the process was recognised early on: the adversary must also be prevented from exerting similar control over one's own side. By the early 1970s, with advances in cybernetic thinking between systems, the role of reflexive control directed at the adversary's decision-making had been recognised, the inadequacy of game theory in the modelling of real decision-making processes had been noted, mathematical modelling of decision-making had been developed under the auspices of Vladimir Lefebvre and the Moscow Methodological Club, and the need for automated and protected information processing as part of the control over the adversary's decision-making had been identified.

Researchers have claimed that reflexive control was a classified topic in the Soviet Union, or that attempts had at least been made to keep it secret. However, these claims have been proven wrong in this study: a large number of books on the subject were published in the Soviet Union, scientific conferences discussing the topic were held, and the concept was defined in the 1974 Encyclopaedia of Cybernetics. In the Soviet system, an encyclopaedia documented the officially approved truth, which means that the appearance of the term in such a publication officially sanctioned the existence of reflexive control. The only reference to secret efforts is the claim by Lefebvre that development work was carried out under the auspices of the KGB.

The study presents that comprehensive development of reflexive control continued in the Soviet Union in the 1980s and that there was also interest in the work in the West (as part of the research on Soviet activities), especially in the United States. It is

suggested in the study that this was mainly prompted by the emigration of Vladimir Lefebvre to the United States in 1974 and the works on reflexive control and the differences in ethics between the West and the Soviet Union behind it that he published in the United States in 1984. In a key conclusion, it is noted that by the mid-1980s it had been realised that reflexive control can only be successfully applied if a comprehensive plan setting out a response to every movement of the adversary or every random incident is prepared.

One of the most important conclusions made in this study (which also requires additional research) concerns the impacts of the disintegration of the Soviet Union on the debate on military theories in Russia. Drawing on the sources collected for the study, the author tried to outline how the social collapse may have impacted the assumptions behind reflexive control or its development. It transpired that there was surprisingly little debate on the disintegration of the Soviet Union and the defeat in the confrontation between ideologies in Russian military journals. Reflexive control was not touched in the discussion either. The assumptions that all world events are objectively true and dialectically connected to each other (and thus reflected in human consciousness) did not disappear with the collapse of the Soviet Union and the ideology behind the assumptions. At the same time, however, it should be noted that the dominant view in the Russian debate in the years that followed was that the confrontation with the United States, fought as an information war, did not end with the dissolution of the Soviet Union: as the confrontation between societies continued, there was no need to question earlier assumptions.

Most of the source material used in the study is from the first two decades of the 2000s. At the start of the 2000s, there was interest in reflexive control in Russia and in the West and there was academic debate on the topic in a variety of different publications. In addition to Lefebvre, Timothy Thomas, a US researcher who had studied articles written by Vladimir Lepsky, also contributed to this discussion. He has probably written more about the subject than anybody else in the West and he is also the Westerner whose writings have been most frequently quoted by other researchers. Against the background of further theoretical development, there was more detailed analysis of the systemic approach from the early 2000s onwards. In this approach, a deception plan to prepare and execute a reflexive control operation is created in conjunction with the actual operational plan. It was concluded in the study that during the first two decades of the 2000s, theoretical development of control based on reflexion between systems continued in Russia and that at the same time, efforts were made to use it in military and counter-terrorism operations. The expansion of the reflexive perspective from cybernetics and psychology to nearly all fields of science ran parallel to this development stage.

The theoretical part of the study concludes with an observation that from the early 2010s onwards, there were also calls for practical applications of reflexive control. Chausov was the first researcher to take up the task. In his view, a technologically inferior party may find ways to seize the initiative and, using its own determination, it may be able to impose its will on the enemy. An article by Makhnin describing how to apply the theory in practice was published in 2012. It describes how by analysing past experiences and operational plans in which the aim had been deceive the enemy, it had been noted how reflexive influence could be exerted by means of *simulacra* (false

information perceived as true). Such methods may have been used in the information operations directed at Ukraine, as was noted in the introduction to this study.

It can be concluded from the articles on reflexive control published over the past ten years that there has been a shift in Russia from reflexive equations towards reflexive control over the adversary that can be used in practical combat operations. The model presented by Kazakov, Kiryushin and Lazukin combines reflexive control and Russian version of mission command into an instrument to achieve the same goals and to coordinate the use of troops. The conclusion was that in Makhnin's view, reflexive control is a comprehensive model, in which each of the information packets sent to the adversary that is based on the inputs of the real world, the information world or the psychological world, is analysed from reflexive perspective.

4.3 Practical application of reflexive control theory

In this chapter, the author attempts to describe the use of reflexive control systems based on the theories of Makhnin and Kazakov, Kiryushin & Lazukin. Illustrating the description with an example, the author discusses a possible strategic-level plan for reflexive control and its potential goals. The author also prepares a package of two-level control in conjunction with the example.

In the example, reflexive control is applied to change military decision-making at government level to ensure that it would be in accordance with the wishes of the country exerting the control. In that case, in the way described by Makhnin, the first function in the reflexive control is to shape the observations made in the system to be controlled. To achieve this, the decision-makers of the system exerting control must plan methods influencing the military situational assessment created by the controlled system that help to achieve the goals set by their own government.

Subjecting the inputs to reflexive variations is the second phase of reflexive control in Makhnin's model. The aim is to prompt the adversary to use the reflexive variations of these inputs as inputs in its own decision-making. In his article, Makhnin emphasises the fake nature of the inputs (simulacra). However, variations based on real events (such as military exercises and troop movements) can also be used to persuade the adversary's decision-makers to act in a desired manner.

In Makhnin's view, the sequence of the inputs is the key element in the next phase. Some of the inputs can first be placed in rapid communications channels, such as social media, after which they can be conveyed (in slightly expanded form) through other channels. Attempts may also be made to publish the same inputs through several channels simultaneously.

The two-level control method presented by Kazakov, Kiryushin & Lazukin can also be used to understand the practical manifestations of reflexive control.
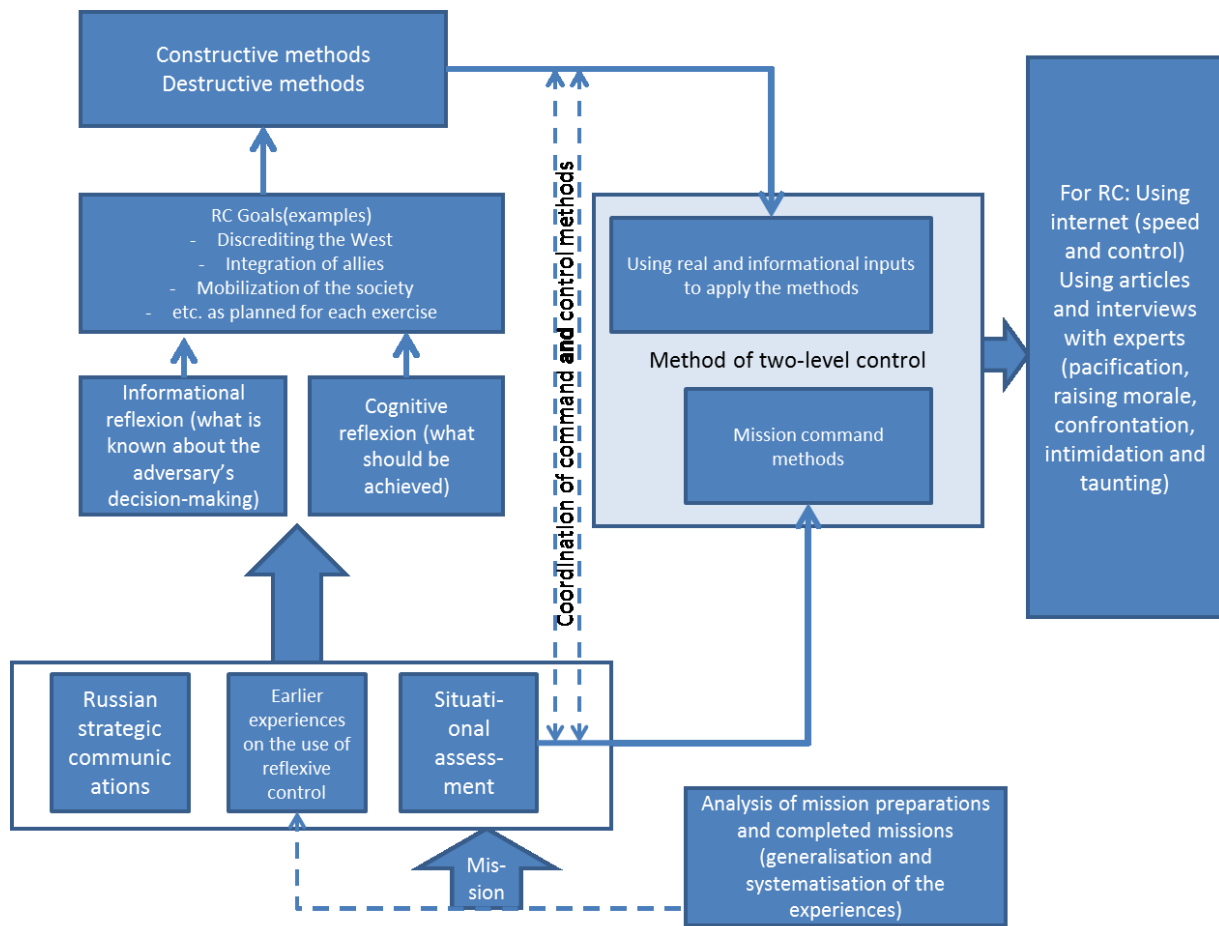
FIGURE 8: Example of practical application of two-level control

The assumption is that using the method they have presented, the strategic communications at government level, and past experiences are used as a basis for the action. It is also assumed that informational reflexion is used when future action on the basis of this information is planned. In this approach, the adversary's situational assessment and the information on one's own troops and operations possessed by the adversary are analysed. This information forms the basis for the use of reflexive control.

Using the situational assessment as a basis, cognitive reflexion is applied by assessing the criteria used by the adversary in its decision-making. According to Kazakov, Kiryushin & Lazukin, the country's leadership must in such situations prepare the goal for reflexive control, which is then broken down into constructive and destructive methods. These are put into practice using a variety of real-world and information-world inputs, which will produce real or simulated information packets for the adversary's system. The packets are distributed through a variety of different channels, and each of the channels has been given specific targets for exercising reflexive control. These packets are used to steer the adversary's decision-making in a desirable manner in accordance with a predetermined plan.

4.4 Systemic thinking in Russian strategy

During the study the author also familiarised himself with wider aspects of system-theoretical thinking in Russia and the Russian military doctrine. The main focus in this study was on the development of reflexive control directed at command and control. The way in which the findings could contribute to the academic debate on Russian strategic thinking (or the lack of such thinking) are discussed in this section, and the view expressed by scholars in the past that the Russian military action is not based on any comprehensive strategy is analysed in more detail.

There was already systemic thinking in Czarist Russia during the first decades of the 20th century, and it developed rapidly as part of cybernetic thinking in the early years of the 1960s. Dialectical ideas about the objective nature of reality and the observer also fit into systemic thinking. The author has also concluded that the modelling of military and political systems on the basis of cybernetics and systems thinking that started in the Soviet Union has continued in Russia, and that the approach differs from Western traditions. Already in 1991, Bezuglii & Gavrilenko suggested that the focus in the modelling of systems should not only be on battle systems but that consideration should also be given to overall political developments. Such an approach in which war is seen as a struggle between social systems is still reflected on the way in which military systems are modelled in Russia.

It is noted in the study that in Russia, systems theory and modelling of systems are approached as a method helping to ensure that wars can be fought in a highly effective manner taking into account the situation and the latest doctrine. Bogdanov & Chekinov in particular, have discussed this idea in their articles over the past few decades. Even though there has also been discussion in Russia on combining military and non-military methods as part of contemporary warfare, war is mostly seen as violent use of armed forces. Other ways of exerting influence, such as information, diplomacy and the economy are given priority when the aim is to avoid war. When this concept is examined on the basis of the *Ends-Ways-Means* thinking prepared by Lykke for the national defence strategy of the United States, it can be noted that in Russia, the *Ways* (doctrines and action) and the *Means* (available resources) are effectively integrated into the systems at the disposal of the country's government. Thus, the desired goals (*Ends*) remain the only strategic-level pillar whose contents are not discussed in public. As a whole, Russia has, as described by Covington and Gressel, managed to mobilise its society for the use of its armed forces much more effectively than the West as part of its comprehensive approach. The Finnish concept of comprehensive security plus the special characteristic of a state aiming to achieve Russian level of control may be the closest analogy. It is highly unlikely that such an entity would not be steered on the basis of a coordinated strategy anticipating interaction between systems.

In reflexive control integrated into interaction between systems and originating from cybernetics and psychology, the inputs fed into the adversary's decision-making system are processed so that the adversary is unaware of being controlled. Exerting control over the adversary's systems using one's own operations and the inputs fed into the adversary's systems was first studied in the Soviet Union in the 1960s. This area of cybernetic control was studied by both military and civilian researchers. In the context of the debate on the absence of a Russian strategy, it is important to note

how systematically the assessment and anticipation of the adversary's activities have been integrated into the command and control of Russian troops at system level and into the field manuals, and how systematically the Russian military is working to achieve this goal at all levels of command.

The model prepared for this study, in which reflexive control is applied as part of the systematic exerting of influence using a variety of different methods and information channels, suggests that Russia uses the analysis of the adversary's command and control systems at all levels. In accordance with its dialectical traditions, Russia takes an analytical and objective approach to all information obtained, and treats them as sources of comprehensive lines of action. Against this background, it is highly unlikely that senior commanders would be solely guided by opportunism. A more likely explanation is that the higher-level strategy is kept secret to ensure that it would not be subjected to reflexive control by the enemy. Lefebvre's suggestion that the adversary gains an advantage if it knows the situational assessment compiled by the other party and the way it is used (doctrine) lends support to this view. The suggestion (already mentioned before) that Russia has deliberately created an impression that its action is unpredictable would seem credible in that case. In this approach, the target for Russian action and the assumed adversary (the West) remain unaware of how Russia will use its doctrine, and is unable to formulate solvable reflexive equations of the options available to Russia.

At the same time, Russia remains able to make opportunistic use of its own situational assessment and information on how Western democracies solve problems and react to threats. Russia is able to exploit identified operating models of the West, which makes it easier to make systematic use of reflexive control. It is probably easier to apply it in countries based on a transparent decision-making process and free civil societies than in countries with authoritarian political systems and strictly controlled media (such as Russia). Even if the majority of the citizens were aware of Russia's real intentions, systematic use of information packets may already create uncertainty and erode citizens' trust in the government and other public authorities. It was already realised during the development of reflexive control in the 1980s that it does not require any feedback channels: sending the information to the adversary is often enough.

Timothy Thomas has suggested that Russia uses reflexive control by manipulating the thoughts of the public to promote its own interests, relying on the media and 'troll armies', drawing parallels with the past and even resorting to violence (Thomas, 2015, p. 117). The conclusion in this study is that such long-term use of cognitive reflexive control requires anticipatory planning and anticipation of the other side's intentions. There have been possible signs of such anticipatory planning and action in conjunction with the occupation of the Crimea, Brexit vote and support for populist parties in Western Europe. Russia had probably started preparing for these situations well in advance, which means that decision-makers had plenty of time and opportunities to produce a comprehensive plan. Accordingly, Russia was able to apply constructive reflexive control methods: influencing opinion, pacification, pressure and transferring of one's own intentions to the adversary's (Ukraine, EU or NATO) systems (cf. Thomas, 2015, pp. 117–118).

In general, modelling of activities on the basis of systemic thinking, and reflexive control should not be ignored when Russian activities are interpreted at strategic level. One has to assume that systemic approach is used as a negotiating tool, in the preparation of strategies and doctrines and in the planning of systems. Moreover, it cannot be assumed that it will disappear if power changes hands in the future, as it will remain part of the Russian approach to problem solving. One also has to assume that Russia bases its action on a long-term strategy, and that it will make every effort to ensure that adversaries cannot exert influence on its ultimate strategic goals.

4.5 Conceptual differences between western 'strategic communication' and Russian 'informational-psychological warfare'

The focus in this study has been on the Russian model of influencing decision-making. At the same time, the author has also given concrete examples to illustrate the differences between Russian and Western approaches to exerting influence. Illustrating and understanding these differences makes it easier to use this study in the future.

According to the American definition, the focus in the Western approach to influencing opinions and impressions (perception management) is to steer the emotions, motives and objective deduction of foreign audiences and decision-makers by conveying to the target audiences selected information and indications or by preventing the target audiences from accessing information. This action is based on presenting the truth in a desired manner, operational security, deception and psychological operations (JP 1-02, 2009, p. 403). In addition to (or instead of) the term 'perception management' the term 'strategic communication' is now also used in the West (the concept originated in the United States). It is described as a government-level activity in which the aim is to reach target audiences, and create, strengthen or preserve conditions that are in one's own interests. Strategic communication is carried out using a variety of different methods and all channels available at government level (JP 1-02, 2016, p. 226).

Analysis of the target audiences and decision-makers and of the way in which the emotions and motives of the target audiences should be understood (subjective background factors) is a key component of these methods. In the subjective (understanding) approach to target audiences and to selecting information, there is a need to use a feedback channel: measuring and assessing whether this action is creating the desired impacts or whether the action should be adjusted in accordance with the feedback has been part of the Western way of influencing opinions ever since the Second World War.

This differs from the Russian approach described in this study: in it, the aim is to determine the situation in advance, and to plan one's own action and the sending of the information in such detail that there is no need for any feedback channel. The assumption in the Russian approach to influencing (which arises from an objective world view) is that by feeding specific information through a specific information channel, the response can be anticipated in advance: the individual's subjective opinions on the information are irrelevant. Moreover, in Russian information operations, there is no differentiation between foreign and domestic target audiences: the action focuses on groups whose opinions are important to achieving one's own goals or that

help to create broader impacts when subjected to information operations. Both domestic and foreign decision-makers are key targets in such activities.

In the Russian theory of information operations, the way in which individual messages are received is unimportant. Conveying one's own narrative and views through a large number of different channels and hoping that they are seized by at least some Western media is the goal. In that case, there is at least something that you can use to back up your case when the issue is discussed at different forums. Not even presenting facts will change this predetermined approach, in which the main aim is to create several alternative truths (instead of one truth), which by their very existence can give rise to doubts. Telling 'tactical truths' and lack of trust between the government and citizens provides a fertile ground for such activities: nobody expects to hear the objective truth from the official channel as people expect everybody to lie to some extent.

The observations made over the past ten years show that Russia has, at least to a certain degree, managed to create such alternative narratives, independently of the objective truth. In the long term, systematic information operations carried out by Russia are also producing results: they create uncertainty and suspicion between citizens and the government. At the same time, efforts are made to steer the opinions of susceptible citizens in polarised societies.

4.6 Critique on the selected approach

The author has decided to approach reflexive control as an umbrella concept. By doing this, the author avoided the problem faced by past research, in which defining reflexive control as a long-term element of information warfare or information-psychological warfare meant that some of the reflexive control methods referred to in the sources had to be omitted. For example, Giles, Seaboyer and Sherr have encountered this problem when trying to define reflexive control as a long-term influencing tool that is solely based on advance planning (Giles, Seaboyer & Sherr, 2018, p. 53). The author decided to divide reflexive control into long-term constructive methods and short-term destructive methods that are applied in different ways. As a result, no limits have been set for the time span of reflexive control.

However, the model prepared for the study is not without problems because using it leaves room for interpretation. The definitions of the methods described in the model are partially overlapping and the translations of the Russian terms are creations of a single researcher. Strict division into constructive and destructive methods also involves challenges: it can be difficult to categorise methods by purpose merely on the basis of interpreting the source material.

Strict differentiation between methods and the need to find desired reflexions in all actions are additional weaknesses in this approach. This may lead to a situation (which existed during the Cold War) in which the mere possibility of doing something is interpreted as an intention of the other party: a neutral text assumes a different meaning when it is interpreted using the 'methods'. It is entirely possible that these methods only exist in researchers' imagination and their determination to find a deeper meaning in all human activities.

The model provides a comprehensive list of the methods described in the source material for reflexive control. At the same time, it also includes actions that can be used even though are not part of reflexive control. The context in which the method is applied should be discussed in connection with each method: is the intention to cause reflexions in the adversary's actions or is it a question of action without any background motivations? When we are examining an identified action by relying on an existing model, we should also take into account that some of the methods may be used for deceptive purposes as part of a more comprehensive plan. In that case, the real targets of these methods are not the same as those specified in the model. In the model, the Russian activities may also come across as more extensive and systematic than is actually the case and create threats that do not actually exist.

How could the model created for this study be applied? With the methods contained in it and the descriptions of their inputs, the model can best be applied to interpreting past action, and it has only limited use as an anticipatory instrument. With regard to anticipation, potentially useful methods can be identified but they can manifest themselves in very different ways. At the same time, however, the changes observed in the methods may also be an indication of the changes in background assumptions influencing Russian thinking, which provides an opportunity to follow developments of the theoretical debate from a wider perspective.

Using the command system targets selected for influence operations and identified in the model, we can also analyse how one's own activities can be protected against such attempts. The model as a whole can also be used as a description of the options available to Russian armed forces and Russian government when they want to apply comprehensive reflexive control. There is a danger that the model is assumed to be comprehensive: it is entirely possible, even likely, that in addition to the methods described in the model there are also other reflexive control procedures not presented in the model.

4.7 Discussion for further studies

The first of the topics for further studies concerns the manifestation of cybernetic and system-theoretical models in Russian military decision-making systems and in the systems supporting them. The matter has already been briefly touched in this study but as the focus here is not on command systems, it was only discussed to the extent required for creating a reflexive model. However, Russia has been continuously developing decision-making systems and especially decision support systems. For example, the establishment of the new Russian national defence command centre in 2016 indicates that a great deal is expected of them in the future. In connection with this, extensive system-theoretical research and research relying on the most recent knowledge could provide us with new information on how Russia is planning to use military force, and what are the support systems (such as simulation) that it is using. According to this study, Russia's capacity to make quick military decisions and project its power is primarily based on a commander-centred approach and comprehensive use of support systems.

The reflexive control model prepared for this study provides a basis for observing the use of different methods and inputs in reflexive control. It could be used in the studies of identified long-term influencing operations, such as Russian actions directed at the Ukrainian government. The material accumulated over the years could be analysed on the basis of models, and the aim could be to illustrate the roles of inputs and information channels and the changes in the methods over time. In this manner, using long-term case examples as a basis, we could analyse the reflexive control plan that may have been used and how it could have been countered at an earlier stage.

Russian military journals, which report on developments from very different angles, could also be a topic of long-term research. Examining how specific topics, such as NATO's EFP troops, are discussed in the journals over the long term, could reveal interesting differences between these publications. It could also help to determine whether they play any role in Russia's information campaigns and reflexive control.

It was also noted in the study that the assumption in reflexive control is that the party applying it is able to anticipate and plan how the other side reacts to the inputs it has received. However, it can be asked whether the consequences of the occupation of the Crimea or the continuation of the war in eastern Ukraine could actually have been anticipated. In other words, what are the potential uncertainty factors inherent in reflexive control? Are there weaknesses in the application of dialectical and objective approach when action is taken in complex and chaotic operating environments where the action often has unanticipated impacts? The willingness and capacity of the current Russian military leadership to engage in self-criticism (critical assessment of its own actions) might also be an interesting research topic. However, there are probably few opportunities for such research as long as the current Russian government is in power.

5. SOURCES

Allen, Robert (2001): The rise and decline of the Soviet economy, Canadian Journal of Economics, Nov 2001, http://content.csbs.utah.edu/~mli/Economics%207004/Allen-103.pdf, retrieved on 7 January 2019

Bartles, Charles & Grau, Lester (2016): The Russian Way of War - Force Structure, Tactics and Modernization of Russian Ground Forces, Foreign Military Studies Office, Ft. Leavenworth, Kansas

Berezkin, A. (1972): On Controlling the Actions of an Opponent, Selected Readings from Military Thought 1963-1973, Studies in Communist Affairs, Vol 5, Part II, US Government Printing Office, Washington D.C

Berdy, Michele (2018): What Kind of Leader is Vladimir Putin, Moscow Times, https://themoscowtimes.com/articles/what-kind-of-leader-is-vladimir-putin-60920, retrieved on 4 January 2019

Berger, Heidi (2010): Venäjän informaatio-psykologinen sodankäyntitapa terrorismin torjunnassa ja viiden päivän sodassa, Maanpuolustuskorkeakoulun Johtamisen ja sotilaspedagogiikan laitoksen Julkaisusarja 1 – Tutkimuksia, Edita Prima, Helsinki

Berzinš, Janis (2014): Russia's New Generation Warfare in Ukraine: Implications for Latvian Defense Policy, https://sldinfo.com/wp-content/uploads/2014/05/New-Generation-Warfare.pdf, retrieved on 20 June 2019

Bezuglii, A.S, Gavrilenko S.P (1991): On the Application of the Science of Systems to Military Systems, Military Thought no. 11, https://dlib.eastview.com/browse/doc/400477, retrieved on 4 January 2019

Blandy, Charles (2009): Provocation, deception, entrapment: the Russo-Georgian five-day war, Advanced Research and Assessment Group, Defence Academy of the United Kingdom, Shrivenham, https://www.files.ethz.ch/isn/97421/09_january_georgia_russia.pdf, retrieved on 20 June 2019

Bogdanov, S. & Chekinov, S. (2015): Modern Military Art in the Context of Military Systematology, Military Thought no. 4, https://dlib.eastview.com/browse/doc/46295534, retrieved on 9 January 2019

Bogdanov, S. & Chekinov, S. (2017): The Essence and Content of the Evolving Notion of War in the 21st Century, Military Thought no. 1, https://dlib.eastview.com/browse/doc/48907735, retrieved on 9 January 2019

Boyd, John R. (1996): The essence of winning and losing. http://dnipogo.org/john-r-boyd/, retrieved on 28 February 2020

Chausov, F. (1999): Osnoviy refleksivnogo upravlenija protivnikom (Основы рефлексивного управления противником), Morskoi Sbornik, no. 1

Chausov, F. (2010): Sovershenstvovanie raboti organa voennogo upravlenija na osnove informatsionni tehnologii (СОВЕРШЕНСТВОВАНИЕ РАБОТЫ ОРГАНА ВОЕННОГО УПРАВЛЕНИЯ НА ОСНОВЕ ИНФОРМАЦИОННЫХ ТЕХНОЛОГИЙ), Morskoi sbornik no. 1, https://dlib.eastview.com/browse/doc/21263574, retrieved on 7 January 2019

Chausov, F. (2011): Nekotoroje podhodi k sovershenstvovaniju sistemi upravlenija voiskami (salami) novogo oblika (НЕКОТОРЫЕ ПОДХОДЫ К СОВЕРШЕНСТВОВАНИЮ СИСТЕМЫ УПРАВЛЕНИЯ ВОЙСКАМИ (СИЛАМИ) НОВОГО ОБЛИКА), Morskoi sbornik no. 6, https://dlib.eastview.com/browse/doc/24565642, retrieved on 7 January 2019

Chotikul, Diane (1986): Soviet Theory of Reflexive Control in Historical and Psychocultural Perspective: A Preliminary Study, Naval Postgraduate School, Monterey, California

Covington, Stephen (2016): The Culture of Strategic Thought Behind Russia's Modern Approach to Warfare, Harvard Kennedy School Belfer Center, https://www.belfercenter.org/publication/culture-strategic-thought-behind-russias-modern-approaches-warfare, retrieved on 4 January 2019

Donskov, Ju., Nikitin.O & Besedin, P. (2015): Intelligent Electronic Warfare Decision Support Systems in Tactical Combined Arms Formations, Military Thought, no. 4, https://dlib.eastview.com/browse/doc/46295546, retrieved on 4 January 2019

Dovzhenko, V. & Zavgorodni, V. (2014): Decision Support for Troop Control, Military Thought no. 3, https://dlib.eastview.com/browse/doc/43148582, retrieved on 4 January 2019

Druzhinin, V. & Kontorov, D. (1976): Voprosi voennoi sistemotehniki (вопросы военной системотехники), Vojennoe Izdateltsvo, Moscow

Ermak, Stanislav & Raskin, Aleksandr (2002): Totshka zrenija. v srashenii vse sposoby horoshi? (ТОЧКА ЗРЕНИЯ. В СРАЖЕНИИ ВСЕ СПОСОБЫ ХОРОШИ?), Armeyskiy Sbornik. no. 7, https://dlib.eastview.com/browse/doc/4338119, retrieved on 7 January 2019

Franke, Ulrik (2015): War by non-military means - understanding Russian information warfare, FOI-R--4065--SE, Swedish defence research agency, http://johnhelmer.net/wp-content/uploads/2015/09/Sweden-FOI-Mar-2015-War-by-non-military-means.pdf, retrieved on 4 January 2019

Furustig, Hans (1994): Vilseledning och påverkan genom reflexive control, Avdelning för humanvetenskap, Försvarets forskningsanstalt (FOA)

Gerasimov, Valery (2013): Tsennost nauki v predvidenii (Ценность науки в предвидении) Voenno-promyshlennyi kur'er no. 8, https: //www.vpk-news.ru/articles/14632, retrieved on 9 January 2019

Gerovitch, Slava (2002): From Newspeak to Cyberspeak - a history of Soviet cybernetics, MIT Press, Cambridge, Massachusetts

Gessen, Masha (2018): Venäjä vailla tulevaisuutta - totalitarismin paluu, Docendo, Jyväskylä

Giles, Keir, Seaboyer Anthony & Sherr James (2018): Russian Reflexive Control, Royal Military College of Canada, Kingston, Ontario, https://www.researchgate.net/publication/328562833, retrieved on 20 June 2019

Gressel, Gustav (2015): Russia's quiet military revolution and what it means for Europe, European Council on Foreign Relations, https://www.ecfr.eu/publications/summary/russias_quiet_military_revolution_and_what_it_means_for_europe4045, retrieved on 4 January 2019

Glushkov, V. (ed.) (1974): Entsiklopedia Kibernetiki, toinen osa, Mih-Jats, Glavnaja Redaktsija, Kiev

Hall, Robert (1991): Soviet Military Art in a Time of Change - Command and Control of the Future Battlefield, Brassey´s, UK

Hakala, Pekka (2018): Venäjän suursota on jo alkanut – Putin näyttää juuri nyt viihtyvän informaatiosodan juoksuhaudassa, Helsingin Sanomat, https://www.hs.fi/ulkomaat/art-2000005641922.html, retrieved on 4 January 2019

Huhtinen, Aki-Mauri, Kotilainen, Noora, Streng, Mikko & Särmä, Saara (2018): Warfare in Hybrid Environment – Reflexive Control as an Analytical Tool for Understanding Contemporary Challenges, Proceedings of the 5th European Conference on Social Media (ed. Cunnane & Corcoran), Limerick Institute of Technology, Ireland, https://bit.ly/2M8e5Is, retrieved on 22 January 2019

Ionov, M. (1971): On the Methods of Influencing an Opponent's Decisions, Selected Readings from Military Thought 1963-1973, Studies in Communist Affairs, Vol 5, Part II, US Government Printing Office, Washington D.C

Ionov, M. (1995a): On Reflective Enemy Control in a Military Conflict, Military Thought no. 1, https://dlib.eastview.com/browse/doc/400862, retrieved on 7 January 2019

Ionov, M. (1995b): Upravlenie Protivnikom (Управление противником), Morskoi Sbornik, no. 7

Ivanov, D, Savelev, V., Shemansky, P. (1977): Osnovy upravlenija voiskami v boju (Основы управления войсками в бою), translation: Fundamentals of Tactical Command and Control, United States Air Force, USA (originally Moscow 1977)

Jaitner, Margarita & Kantola, Harry (2016): Applying Principles of Reflexive Conrol in Information and Cyber Operations, Journal of Information Warfare, Volume 15, Issue 4

Jampolski, S., Kostenko, A. (2017): Using a Situational Approach to Command and Control of Organizational and Technical Systems in Operation Planning, Military Thought no. 2, https://dlib.eastview.com/browse/doc/49108860, retrieved on 4 January 2019

Joint Publication 1-02 (2009): Department of Defense Dictionary of Military and Associated Terms, https://web.archive.org/web/20091108082044/http://www.dtic.mil/doctrine/jel/new_pubs/jp1_02.pdf, retrieved on 20 January 2019

Joint Publication 1-02 (2016): Department of Defense Dictionary of Military and Associated Terms, https://fas.org/irp/doddir/dod/jp1_02.pdf, retrieved on 20 January 2019

Kahneman, Daniel (2003): A Perspective on Judgment and Choice - Mapping Bounded Rationality, American Psychologist, Vol: 58, No: 9, https://pdfs.semanticscholar.org/f714/fb86fd6c05cefe2ccc28ddfbb31cc63ca04c.pdf, retrieved on 20 June 2019

Kahneman, Daniel (2011): Thinking, Fast and Slow, Farrar, Straus & Giroux, New York
Karankevich, Viktor (2006): How to Learn to Deceive the Enemy, Military Thought no. 4, https://dlib.eastview.com/browse/doc/11315229, retrieved on 7 January 2019

Kari, Martti (2018): "Suomalaiset ovat ylpeitä rehellisyydestään – Venäläisten silmissä sitä pidetään vähän tyhmänä, sanoo Venäjästä väitöskirjaa tekevä Martti J. Kari" https://www.hs.fi/teknologia/art-2000005857115.html, retrieved on 20 June 2019

Kazakov, Vladimir & Kiryushin, Alexei (2013): Double-Track Combat Action Control, Military Thought no. 3, https://dlib.eastview.com/browse/doc/43184082, retrieved on 7 January 2019

Kasapoglu, Can (2015): Russia's Renewed Military Thinking - Non-Linear Warfare and Reflexive Control, Research Paper no. 121, Nato Defense College, Rome, http://www.ndc.nato.int/download/downloads.php?icode=467, retrieved on 22 January 2019

Kazakov, Vladimir, Kiryushin, Alexei & Lazukin, V. (2014a): Double-Track Control over Combat Actions, Military Thought no. 3, https://dlib.eastview.com/browse/doc/43148583, retrieved on 7 January 2019

Kazakov, Vladimir, Kiryushin, Alexei & Lazukin, V. (2014b): Sposob kompleksnogo upravleniia boevymi deistviiami (Способ комплексного управления боевыми действиями), Voennaya Mysl no. 5, https://dlib.eastview.com/browse/doc/41174778, retrieved on 8 January 2019

Klein, Gary (2008): Naturalistic Decision Making, Human Factors, 50(3), https://doi.org/10.1518/001872008X288385, retrieved on 4 January 2019

Klimenko, A. (1997: Theoretical-Methodological Problems of Formulating Russian Military Doctrine, and Ways of Addressing Them, Military Thought no. 3, https://dlib.eastview.com/browse/doc/401024, retrieved on 22 January 2019

Kiselyov, Valery (2017): What Kind of Warfare Should the Russian Armed Forces Be Prepared for? - Military Thought, no..2, https://dlib.eastview.com/browse/doc/49108850, retrieved on 4 January 2019

Kolomoyets, F.G (2007): Systems Analysis: Recommendations for Problem Identification, Formulation, and Study, Military Thought, no. 3, https://dlib.eastview.com/browse/doc/13498418, retrieved on 4 January 2019

Komov, S. (1997): Forms and Methods of Information Warfare. Military theory and practice, Military Thought no. 4, https://dlib.eastview.com/browse/doc/401039, retrieved on 7 January 2019

Konstantinov F. V. - Bogomolov A. S. et al. (1972): Marxilais-Leniniläisen filosofian perusteet, Kustannusliike Edistys, Moskova

Lalu, Petteri (2014): Syvää vai pelkästään tiheää, Maanpuolustuskorkeakoulu, Taktiikan laitos, julkaisusarja 1 no. 3, Helsinki

Lazarev, I (1992): For Creating a General Theory of Security, Military Thought, no. 11, https://dlib.eastview.com/browse/doc/400611, retrieved on 4 January 2019

Lefebvre, Vladimir (1967): Konfliktujustshie struktury (конфликтующие структуры), Vysshaya Shkola, Moscow

Lefebvre, Vladimir (1984a): Algebra of Conscience, A Comparative Analysis of Western and Soviet Ethical Systems, D. Reidel Publishing Company, Dordrecht

Lefebvre, Vladimir (1984b): Reflexive Control: The Soviet Concept of Influencing on Adversary's Decision Making Process, Englewood, Colorado

Lefebvre, Vladimir (2002): Second Order Cybernetics in the Soviet Union and the West, Reflexive Processes and Control, no. 2, vol.1, Moscow, online version http://www.reflexion.ru/Library/EJ_2002_1.pdf, retrieved on 4 January 2019

Lefebvre, Vladimir, Kramer, Xenia, Kaiser, Tim, Davidson Jim & Schmidt, Stefan (2003): From Prediction to Reflexive Control, Reflexive Processes and Control, no.1, vol.2, Moscow, online version http://www.reflexion.ru/Library/EJ2003_1.pdf, retrieved on 7 January 2019

Lefebvre, Vladimir (2010): Lectures on the Reflexive Games Theory, Leaf and Oaks Publishers, Los Angeles

Leonenko, S. (1995): Refleksivnoje upravlenie protivnikom (Рефлексивное управление противником), Armeiskij Sbornik, no. 8

Lykke, Arthur (1989): Defining Military Strategy, Military Review no. 5, pp. 9–16, http://cgsc.contentdm.oclc.org/cdm/ref/collection/p124201coll1/id/504, retrieved on 20 June 2019

Makhnin, Valery (2012): O refleksivnii protsessah v protivoborstve sistem (О РЕФЛЕКСИВНЫХ ПРОЦЕССАХ В ПРОТИВОБОРСТВЕ БОЕВЫХ СИСТЕМ), Informatsionnie Voini no. 3, pstmprint.ru/wp-content/uploads/2016/11/INFW-3-2012-6.pdf, retrieved on 7 January 2019

Makhnin, Valery (2013a): Refleksivnye protsessy v voennom iskusstve: istoriko-gnoseologicheskii aspekt, Voennaya mysl no. 2, https://dlib.eastview.com/browse/doc/29135357, retrieved on 7 January 2019

Makhnin, Valery (2013b): Reflexive Processes in Military Art: The Historico-Gnoseological Aspect, Military Thought no. 1, https://dlib.eastview.com/browse/doc/43184111, retrieved on 7 January 2019

Mills, John Stuart (1836): On the Definition of Political Economy, and on the Method of Investigation Proper to It, London and Westminster Review, October 1836, https://oll.libertyfund.org/titles/mill-the-collected-works-of-john-stuart-mill-volume-iv-essays-on-economics-and-society-part-i, retrieved on 20 June 2019

Novikov, Dimitri (2015): Cybernetics: From Past to Future, Russian Academy of Sciences Trapeznikov Institute of Control Sciences, Springer, https://www.researchgate.net/publication/287319297_Cybernetics_from_Past_to_Future, retrieved on 4 January 2019

Peters, Benjamin (2016): How Not to Network a Nation: The Uneasy History of the Soviet Internet. MIT Press, Cambridge, Massachusetts

Polenin, V. (2000): Kritika i bibliografija refleksija - ne universalni sposob upravlenija, (КРИТИКА И БИБЛИОГРАФИЯ. РЕФЛЕКСИЯ - НЕ УНИВЕРСАЛЬНЫЙ СПОСОБ УПРАВЛЕНИЯ), Morskoi Sbornik no. 7. https://dlib.eastview.com/browse/doc/218829, retrieved on 7 January 2019

Pynnöniemi, Katri & András Rácz (ed.) (2016): Fog of Falsehood -Russian Strategy of Deception and the Conflict in Ukraine, FIIA Report 45, Finnish Institute of International Affairs, Helsinki

Raskin, A. (2015): Refleksivnoje upravlenie v sotsialnii setjah, (РЕФЛЕКСИВНОЕ УПРАВЛЕНИЕ В СОЦИАЛЬНЫХ СЕТЯХ), Informatsionnie voini, no. 3, 2015, http://media.wix.com/ugd/ec9cc2_5ef84c90678043e389fdfa73126b8683.pdf, retrieved on 14 June 2019

Reid, Clifford (1987): Reflexive Control in Soviet Military Planning, in: Dailey, Brian & Parker, Patrick (ed.): Soviet Strategic Deception, Lexington Books, USA

Ryabchuk, V. (2001): Combat Control and Commander's Intellect, Military Thought no. 4, https://dlib.eastview.com/browse/doc/400153, retrieved on 4 January 2019

Roth, Andrew (2019): Russia moves to mask its soldiers' digital trail with smartphone ban, http://www.theguardian.com/world/2019/feb/19/russia-moves-to-mask-soldiers-digital-trail-with-smartphone-ban, retrieved on 14 June 2019

Semenov, Igor (2017): "Polifonicheskaia personologiia V.A. Lefevra i fundamental'noe razvitie refleksivnykh nauk o cheloveke i vselennoi" (Полифоническая персонология В.А. Лефевра и фундаментальное развитие рефлексивных наук о человеке и вселенной), Psikhologiia. Zhurnal Vysshei shkoly ekonomiki. no. 4, pp. 607-625, https://psy-journal.hse.ru/data/2018/10/07/1157351175/385-779-1-SM.pdf, retrieved on 20 June 2019

Simon, Herbert (1955): A Behavioral Model of Rational Choice. The Quarterly Journal of Economics, no. 1, pp. 99-118, https://www.suz.uzh.ch/dam/jcr:ffffffff-fad3-547b-ffff-fffff0bf4572/10.18-simon-55.pdf, retrieved on 20 June 2019

Skortsov, A., Klokotov, N. & Turko, N. (1995): Use of Geopolitical Factors In Order To achieve National Security Objectives, Military Thought no. 2, https://dlib.eastview.com/browse/doc/400870, retrieved on 7 January 2019

Spirkin, Alexander (1983): Dialectical Materialism, Progress, Moscow, online version https://www.marxists.org/reference/archive/spirkin/works/dialectical-materialism/index.html, retrieved on 4 January 2019

Surovikin, Sergei & Kuleshov, Juri (2017): Osobennosti organizatsii upravleniia mezhvidovoi gruppirovkoi voisk (sil) v interesakh kompleksnoi bor'by s protivnikom (Особенности организации управления межвидовой группировкой войск (сил) в интересах комплексной борьбы с противником), Voennaya mysl', no. 8, https://dlib.eastview.com/browse/doc/49166188.

Susiluoto, Ilmari (1982): The Origins and Development of Systems Thinking in the Soviet Union, Suomalainen Tiedeakatemia, Helsinki

Susiluoto, Ilmari (2006): Suuruuden laskuoppi. Venäläisen tietoyhteiskunnan synty ja kehitys, WSOY, Helsinki

Thomas, Timothy (2002): Reflexive Control in Russia: Theory and Military Applications, Reflexive Processes and Control, no. 2, http://www.reflexion.ru/Library/EJ_2002_2.pdf, retrieved 18 June 2019

Thomas, Timothy (2004): Russia's Reflexive Control Theory and the Military, Journal of Slavic Military Studies 17, Taylor & Francis Online, https://www.tandfonline.com/doi/abs/10.1080/13518040490450529 (retrieved on 4 January 2019)

Thomas, Timothy (2011): Recasting the Red Star: Russia Forges Tradition and Technology through Toughness, Foreign Military Studies Office, Ft. Leavenworth, Kansas

Thomas, Timothy (2015): Russia Military Strategy - Impacting 21st Century Reform and Geopolitics, Foreign Military Studies Office, Ft. Leavenworth, Kansas

Thomas, Timothy (2016): Thinking Like a Russian Officer: Basic Factors and Contemporary Thinking on the Nature of War, Foreign Military Studies Office, Ft. Leavenworth, Kansas

Thomas, Timothy (2017): Kremlin Kontrol: Russia's Political-Military Reality, Foreign Military Studies Office, Ft. Leavenworth, Kansas

Tieteen termipankki (2019): Estetiikka: simulakrumi, h*ttps://tieteentermipankki.fi/wiki/Estetiikka:simulakrumi,* retrieved on 8 January 2019

Tikhanitsev, O. (2012): Decision-Making Support Systems: Prospects for Troops Control Automation, Military Thought no. 3, https://dlib.eastview.com/browse/doc/43184099, retrieved on 4 January 2019

Veprintsev, V., Manolio, A., Petrenko, A. & Frolov, D. (2011): Operatsii informationno-psihologitseskoi voini. Kratkii entsiklopeditseskii slovar-spravotsnik (Операции информационно-психологической войны. Краткий энциклопедический словарь-справочник), Gorjatsaja linija - Telekom, Moscow

Volostnov, G. & Golod, Ja. (1992): Problems of Command and Control Theory Terminology, Military Thought no. 10, https://dlib.eastview.com/browse/doc/400604, retrieved on 4 January 2019

Vorobyov, Ivan (2002a): The Principles of Combat as the Theoretical Backbone of the Art of Tactics, Military Thought no. 2, https://dlib.eastview.com/browse/doc/4267632, retrieved on 4 January 2019

Vorobyov, Ivan (2002b): Tactics as the Art of Command and Control, Military Thought no. 4, https://dlib.eastview.com/browse/doc/4640893, retrieved on 4 January 2019

Vorobyov, Ivan (2003): Tactics as the Art of Command and Control, Military Thought n:o 1, https://dlib.eastview.com/browse/doc/4877067, retrieved on 4 January 2019

Vorobyov, Ivan & Kiselyov, Valery (2008): Evolution of Principles of Military Art, Military Thought no. 3, https://dlib.eastview.com/browse/doc/24406048, retrieved on 4 January 2019

Vorobyov, Ivan & Kiselyov, Valery (2011): From Present-Day Tactics to Network-Centric Action, Military Thought no. 3, https://dlib.eastview.com/browse/doc/43184031, retrieved on 4 January 2019

Vygovsky, I & Davidov, A. (2017): Improving the Organization of Automated Control in the Military Sphere, Military Thought no. 4, https://dlib.eastview.com/browse/doc/50290440, retrieved on 4 January 2019

Värnqvist, Peter (2016): Reflexiv kontroll: evig metod som systematiserats?, Försvars-högskolan, http://fhs.diva-portal.org/smash/get/diva2:1040782/FULLTEXT01.pdf, retrieved on 20 June 2019

Wiener, Norbert (1961), originally 1948 (1st edition): Cybernetics - or control and communication in the animal and the machine, 2nd edition, MIT Press, Cambridge, Massachusetts

Wikipedia (2019), Рефлексивное управление, https://ru.wikipedia.org/wiki/Рефлексивное управление, retrieved on 25 January 2019

Examples of how simple reflexive equations are used

Marking of reflexive equations and their use in the modelling of reflexive control is illustrated in this appendix with the help of simple examples. The examples are from the book published by Vladimir Lefebvre in 2010 (Lefebvre, 2010, Chapters 9 and 13).

1. Direct influence. Expression: a wants b to select x and exerts direct influence to achieve its goal.

In this situation, b may choose among options available in series $\{0, 1\}$
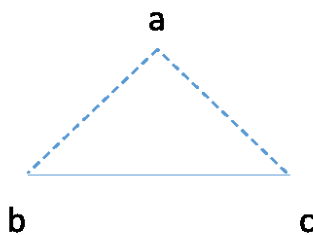
The figure can be made into a polynomial
$a+bc$
which can be written as:

$$[b]\ [c]$$
$$[a]\ +\ [bc]$$
$$[a+bc]$$

Equation in target b can be written as:
$b = a + bc$
or
$b = (a + c)b + a\overline{b}$
$A = a + c, B = a, A \supseteq B$,
which means that all values of b in the interval
$(a + c) \supseteq b \supseteq a$
are solutions of the expression $b = (a + c)b + ab$.

If $c = 0$,
$a \supseteq b \supseteq a$,
it follows that $b = a$.
If a wants b to select 1, influence of a on b should be 1. If a wants b to select 0, influence of a on b should be 0.

If *c = 1*,
1 ⊇ b ⊇ a

If *a = 1*, it follows that *b = 1* (*b* acts in accordance with *a*'s choice). If *a=0*, *b* has freedom of choice and *b* does not necessarily act in accordance with *a*'s choice. It follows that *a* can encourage *b* to select *1* but cannot force *b* to select *0*.

2. Practical example. Detached battalion *d* is planning to descend from the mountains into the valley. The enemy contingent *a* wants to prevent the battalion from descending from the mountains. All routes to the valley go through villages *b* and *c*. Residents of the villages are hostile towards the battalion and support the enemy. The residents are also hostile to each other. The interdependencies can be described using the following figure:
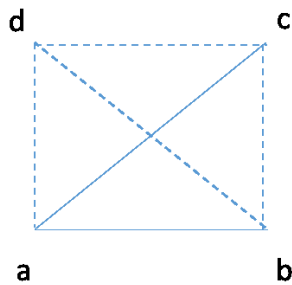
The set of routes available to the commander contains all routes that the battalion can use to descend from the mountains into the valley. The assumption is that they cannot be combined, which means that the battalion can only use one route. The set of options *M* contains all available routes that the battalion will not use. When considering routes in set *a*, the commander must take enemy action into account. For example, there are routes that are not under enemy control, which means that the commander may be inclined to select one of them. When considering routes in sets *b* and *c,* the commander may take into account the activities of the village residents. The figure can be made into a polynomial

d + a(b + c)

the content of which can be described using the following expressions:

$$[b]+[c]$$
$$[a][b+c]$$
$$[d+[a(b+c)]$$
$$[d]+[a(b+c)]$$

The expression describing the decision-making of the battalion commander is as follows:

d=d+a

This equation does not include variables *b* or *c*, which means that the hostility of the residents does not play any role when the commander makes his decision. Solving the equation produces:

1 ⊇ d ⊇ a.

If *a* is not an empty set, the battalion commander can select any option containing the subset *a*, after which he can select any of the options of this subset (specific routes). When *a=0* or the enemy does not attempt to persuade the commander to select any particular route, the commander may select any of the options (including an empty set). If the selected option is not an empty set, the commander can specify the route that the battalion uses to enter the valley.

In this example, reflexive control manifests itself as follows: The enemy commander decides to ambush the battalion on one of the routes and decides to use reflexive control. If he uses *a = 1* to exert influence and manages to convince the battalion commander that all routes leading to the valley are safe, he cannot predict which of the routes the battalion will use and ambush the contingency. If he uses *a = 0* to exert influence (all routes are dangerous) the result will be the same. The best option would be to persuade the commander to select the route *a* or use *a={ a}* to exert influence. In that case, the commander's choice can be described using the expression 1 ⊇ d ⊇ {α} (the commander selects the route from subsets, each of which contains *a*).

FINNISH DEFENCE STUDIES:

1. *Evolution of the Finnish Military Doctrine 1945–1985*
   Pekka Visuri, 1990

2. *Flank or Front: An Assessment of Military – Political Developments in the High North*
   Tauno Nieminen, 1991

3. *Non Offensive Defence: A Criteria Model of Military Credibility*
   Arto Nokkala, 1991

4. *Development of Military Technology and its Impact on the Finnish Land Warfare Doctrine*
   Markku Koli, 1992

5. *The Impact of Arms Technology on Military Doctrines*
   Pertti Salminen, 1992

6. *The Baltic Republics: A Strategic Survey*
   Erkki Nordberg, 1994

7. *Finlands Security in a Changing Europe: A Historial Perspective*
   Risto E.J. Penttilä, 1994

8. *Ålands Islands: A Strategic Survey*
   Anders Gardberg, 1995

9. *The Baltic – Sea of Changes*
   Mikko Viitasalo and Bo Österlund, 1996

10. *Air Defence in Nothern Europe*
    Heikki Nikunen, 1997

11. *The New Geopolitics: The World System and Nothern Europe Seen from a Modern Geopolitical Perspective*
    Osmo Tuomi, 1998

12. *Russia's Geopolitical Interests in the Baltic Area*
    Ari Puheloinen, 1999

13. *Future Operational-Tactical Level Warfare: Challenges and Opportunities for the Defence of Finland*
    Pekka Toveri and Heikki Välivehmas, 2000

14. *Intelligence in Peace Support Operations*
    Pasi Välimäki, 2000

15. *Civilian – Military Cooperation in Crisis Management Operations*
    Petteri Kurkinen, 2004.

16. *The Soviet Plans for the North Western Theatre of Operations in 1939–1944*
    Ohto Manninen, 2004

17. *Towards East or West? Defence Planning in Finland 1944–1966*
    Vesa Tynkkynen & Petteri Jouko, 2007

18. *Reconstructing Finnish Defence in the Post-Cold War Era*
    Jyri Raitasalo, 2010

19. *Finnish Threat Perception Policy in the Early Years of the 21st Century*
    Jarno Limnéll, 2012

20. *Exploding Wilderness: Guerrilla-type Activities in the Finnish Art of War*
    Marko Palokangas, 2015

21. *See You in New York: ISIS and the Strategic Evolution of the Jihadist Movement*
    Antti Paronen, 2018

► Past volumes of Finnish Defence Studies in pdf-format:
 http://bit.ly/1S57Rta