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Missile Innovation and Strategy of China´s People´s Liberation Army (PLA)

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List of Abbreviations

CASC	China Aerospace Science and Technology Corporation
CJ	Changjian (‘Long Sword’), series of cruise missiles
CSC	Central Special Commission
DF	Dongfeng (‘Eastern Wind’), series of ballistic missiles
GLCM	Ground-launched cruise missile
HN	Hongniao (‘Red Bird’), series of cruise missiles
ICBM	Intercontinental ballistic missile
IRBM	Intermediate-range ballistic missile
MRBM	Medium-range ballistic missile
NATO	North Atlantic Treaty Organization
NDSTC	National Defense Science and Technology Commission
PLA	People’s Liberation Army
PLARF	PLA Rocket Force (formerly: Second Artillery Corps)
PRC	People’s Republic of China
R&D	Research and development
SLBM	Submarine-launched ballistic missile
SRBM	Short-range ballistic missile

I. Introduction

Innovation in the military realm is critical to warfare and transition of power in the international system (Horowitz/Pindyck 2023, 85). It has been subject of debate since the earliest writings on warfare and is carried on in International Relations research to this day, particularly in the field of Strategic Studies. (Grissom 2006, 905) Key questions revolve around why and how military innovation occurs, yielding distinct theories on what drives innovation and how states succeed in adopting novel military technologies. These questions have practical implications: Due to the challenges of developing high technology in combination with the political ambitions to shape foreign and defense policy, governments need to find ways to successfully innovate and adopt military technologies.

The theoretical debate on military innovation is extensive, however, it exhibits two pertinent deficiencies: First, it largely treats factors involved in the innovation process as intervening variables (Horowitz/Pindyck 2023, 85), not as causal factors engaging in a process. Second, the foremost theories of military innovation lack application outside of the contexts of their formulation; most case studies deal with innovations occurring in the US and Europe (cf. Grissom 2006).

This study attempts to address these shortfalls by employing a qualitative theory-driven analysis to answer the following research question: *How do states successfully innovate and adopt novel military technologies?* This longstanding question is to be examined using the crucial case of China, particularly that of the People's Liberation Army (PLA) missile development programs between the 1960s to 2010s.

Based on existing theory in the field, a theory-test is designed that is suitable to examine the causal relationships involved in the successful operationalization of novel military technology. This includes testing the civil-military model of military innovation as a hypothesized driver of innovation, prefixed to the *Ecosystem Challenge* theory which serves as an explanatory model for successful innovation and diffusion of military technologies. These two approaches are combined in a causal mechanism that is then to be tested for its consistency with empirical evidence from the case study.

The mechanism hypothesizes causal relationships from the initial interest of a government in an innovation (X) to the successful adoption of said innovation (Y). Under the conditions of military innovation being advanced within the traditional defense sector in response to a lack of a specific capability within the existing posture, the causal mechanism is hypothesized as follows: (1) The government *mandates* change in the military's doctrinal development (2) the government *spearheads* the military R&D effort to ensure success in meeting the *Platform Challenge*. (3) The military subsequently responds to the successful innovation by *enabling* the fielding of the new system, thereby meeting the *Adoption Challenge*.

This study unfolds as follows: Firstly, the research design is laid out by illustrating process-tracing methodology and its application to this study's research question. Secondly, a review of the relevant literature in the field of military innovation research is conducted. Based on the findings, a theoretical framework is developed in a third step; this entails the conceptualization of the causal mechanism that is to be tested. Fourthly, based on pertinent case selection criteria, the case selection is substantiated. Fifthly, the empirical analysis is conducted. Finally, this study concludes with a discussion of the findings.

II. Research Design

Process-tracing is a tool of qualitative within-case analysis and enables the identification of causal processes between an independent variable and the dependent variable (an outcome).[1] This method goes beyond mere correlations between X and Y and examines diagnostic evidence to describe political phenomena and assess causal claims. (Beach/Pedersen 2013, 1f., 5) Process-tracing is therefore a suitable method for “evaluating prior explanatory hypotheses, discovering new hypotheses, […] assessing these new causal claims [and] gaining insights into causal mechanisms” (Collier 2011, 823).

Beach/Pedersen (2013) distinguish three types of process-tracing methods that differ along the intended purpose of the research design: In (a) Theory-Testing Process Tracing, causal mechanisms are formulated by adjusting existing theorizations to the case which can then be tested for their presence in a case study; in (b) Theory-Building Process Tracing, a lack of theorization is addressed by conducting a structured analysis of empirical material in order to theorize a new causal mechanism; and through (c) Explaining-Outcome Process Tracing, the scholar seeks to explain puzzling or otherwise interesting outcomes of a specific case. (Beach/Pedersen 2013, 11ff.) Given the extensive body of literature and theoretical debate on military innovation, theory-testing process-tracing is the method of choice; its properties and application in this study’s design are now elaborated on.

Theory-testing process-tracing is a theory-centric approach; the ambition of this method lies in conceptualizing causal mechanisms that prove to be systematic law-like generalizations of processes in the social world. They are used to study whether X contributes to producing Y; their validity is tested by examining whether all of its parts are present and function as expected. Therefore, the inference made is merely on the presence/absence of the hypothesized mechanism, not on its explanatory sufficiency within the case. (Ibid., 11ff., 36f., 75)

Building a Causal Mechanism

The causal mechanism linking X and Y is hypothesized using existing theorization[2] in order to subsequently test whether this mechanism is present in the selected case. First, this requires

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[1] Process-tracing as described by Beach/Pedersen (2013) bases on a mechanismic and deterministic understanding of causality. Disregarding contextual factors, a causal mechanism can be portrayed as: $X \rightarrow [(n_1 \rightarrow) * (n_2 \rightarrow)]\ Y$. X sends a causal force through the mechanism composed of part 1 (entity 1 and an activity) and part 2 (entity 2 and an activity) producing the outcome Y. (Beach/Pedersen 2013, 29f.) For an overview of the ontological debate of causality, cf. ibid. 23-44.

[2] Collier distinguishes four types of *knowledge* (existing approaches) that can serve as a basis for descriptive and causal inference: (a) Conceptual frameworks, (b) recurring empirical regularities, (c) theory-I and (d) theory-II.

conceptualizing a causal mechanism between X and Y and delimiting the context in which the causal mechanism is theorized to be functional (scope conditions). In deducing the causal mechanism, the *parts* composing the mechanism are designed as theoretical expectations in a step-by-step process. Each part consists of entities engaging in activities. Second, the theoretical expectations of the parts of the causal mechanism are to be rendered into predictions about their empirical manifestation in the case. (Ibid., 14f.; Collier 2011, 823) As theoretical concepts are contested, they are to be properly defined and delimited (while acknowledging the existing semantic debate in the field) in order to determine what is/is not included in a concept. This is done prior to and in line with the theorization process of the causal mechanism. Moreover, the parts of the causal mechanism are to be operationalized in a way that allows for testing their presence/absence in the case by stipulating empirical expectations.

Testing the Causal Mechanism

Then, empirical evidence is used to test (a) whether the hypothesized mechanism was present in the case, and (b) whether the mechanism functioned as predicted. In other words, the empirical analysis serves as a means of testing the existence of each one of the theorized parts; it does not, however, serve as an analysis of empirical events in the case. The theorized causal mechanism is present and functions as predicted if the case-specific entities and their engagement in activities are observable in the analyzed empirical evidence. This approach follows the Bayesian logic which postulates that it is not the number of pieces of evidence but the predictability of the evidence that strengthens the inference. Thus, theory-tests are strongest when precise predictions about the evidence are made. (Beach/Pedersen 2013, 15f., 83, 101) In other words, it is not the mere correspondence of the predictions with evidence found that constitutes a strong theory-test; it is the type of evidence found that strengthens the causal inference.[3]

Conceptual frameworks link sets of interrelated concepts with first indications for operationalization. Recurring empirical events are patterns that indicate a correlation and possibly causality. Theory of the first type is built on regularities and connects them with a hypothesis whereas theory of the second type is a full-fledged explanatory model of those empirical regularities. (Collier 2011, 824)

[3] How the theory test's strength is increased in practice and how evidence is to be treated in the empirical analysis is further laid out in Ch. 6.

III. Literature Review

In order to apply theory-testing process-tracing, a theoretical framework is to be developed that allows for the examination of the research question. This requires finding existing theorizations that (a) can serve as a starting point for the examination, that (b) can be adjusted to the research question in terms of their properties and that (c) are suitable for re-conceptualization as a causal mechanism. Moreover, the research question is to be located within the realms of existing research to substantiate its relevance.

Theories of Military Innovation

The field of military innovation studies is rich in research. Theories of military innovation generally deal with when and how military innovation occurs and diffuses, however, disputes over fundamental questions remain. To date, there is no consensus on a unified definition of military innovation. Disregarding such variations in the understanding of military innovation, Grissom grouped the theoretical debates along their proposed drivers in his influential article *The Future of Military Innovation Studies* (2006) and distinguished four major schools of thought: (a) the Civil-Military, (b) the Interservice, (c) the Intraservice, and (d) the Cultural Model of military innovation. (Grissom 2006, 907f.) Firstly, the *civil-military model* posits that innovation occurs when statesmen intervene in military doctrinal development. While originally developed in Posen's seminal work *The Sources of Military Doctrine* (1984), several empirical studies substantiate the role of civil-military dynamics as drivers of innovation.[4] Secondly, the *interservice model* argues that innovation occurs when military services compete with each other over limited resources. As Armacost (1969) and Sapolsky (1972) establish, competition between services of the same military catalyzes innovation because the services seek to maintain and expand their mission portfolio, budget and prestige.[5] Thirdly, the *intraservice model* contends that innovation is accomplished through a negotiation process within a service. Rosen (1991) argues that innovation occurs when new concepts of warfighting attract support within the senior command, thereby leading to the establishment of new

[4] e.g., Beard (1976) analyzes the case of civilian intervention in the development of the United States' intercontinental ballistic missile (ICBM) development program. Similarly, Zisk (1993) showed that Soviet civil servants played a key role in the military's development of doctrinal responses to NATO planning. (Grissom 2006, 909f.)

[5] e.g., Sapolsky (1972) based his theory on the case of the US' Navy and Air Force competing over the development of the *Polaris* submarine-launched ballistic missile (SLBM). Likewise, Armacost (1969) used the case of US' Army and Air Force competing over the development of the nuclear-capable *Thor* and *Jupiter* intermediate-range ballistic missiles (IRBM); similarly, Bacevich (1986) used the similar case of the development of road-mobile tactical nuclear missiles by the US Army. (Ibid., 911ff.)

branches within the same service.[6] Lastly, the *cultural model* assumes that technological opportunities can be rejected or embraced, based on the respective cultural context set by senior service leaders, thereby leading/not leading to military innovation.[7] Grissom contends that the four schools of military innovation solely treat the origins of innovation because they base on the premise that military organizations are inherently inflexible and require external factors that drive innovation. This leads Grissom to his main critique of the debate: Despite evidence of bottom-up innovation, existing research exclusively treats military innovation as a top-down process. (Grissom 2006, 919f.)

Recent Trends in Military Innovation Studies

Grissom's critique has visibly influenced the debate in the field, leading to growth in research dealing with bottom-up dynamics in military innovation.[8] Due to the proximity of the 'bottom' to the level of the individual soldier, the field of military innovation studies is now significantly influenced by interdisciplinary research, incorporating research from fields such as sociology, management studies or culture studies (Griffin 2017, 197, 203). This trend concurs with the rise of cultural approaches (as in Grissom's fourth school) and is treated separately below.

In another trend, the dealing with the concept of (military) innovation itself is criticized, citing two flaws: Firstly, as already outlined above, Horowitz and Pindyck criticize the lack of consistency in the dealing with concepts in the field (Horowitz/Pindyck 2013, 86). Similarly, Griffin points out the vulnerability of the debate to intertextual issues (Griffin 2017, 203). This prompts the question of what the existing theories explain in the first place and whether the explained is comparable. Recently, Horowitz and Pindyck conducted a survey for mapping the theoretical differences in the large array of definitions of military innovation. While definitions vary significantly, the occurrence of organizational change as a key factor is largely agreed upon whereas the role of technology, tactics, political purposes, success and the innovation

[6] Rosen (1991) deals with a large array of cases of military innovation, most of which drawn from US military policy between 1905 and 1960. Engel (1994) describes the case of the US Navy aviation community which sought to maintain its surface strike capabilities in the form of air-to-surface missiles and resisted the Navy's surface warfare community's initiatives to develop surface-to-surface capabilities. Years later, this resistance was overcome, finally leading to the development and adoption of the *Tomahawk* cruise missile. Cote (1998) built his argument on the development of the *Trident* SLBM which, unlike the interservice model would suggest, did not lead to more innovation within the US Air Force, thus making the case for the intraservice model. Other case studies using this model include Giese (1999), Davis (1967) and Coffey (2000). (Ibid., 911f., 914ff.)

[7] e.g., Farrell (1998) and Farrell/Terriff (2002).

[8] e.g., King (2010), Kollars (2015) or Marcus (2015) deal with bottom-up innovation by analyzing the counterinsurgency wars in Afghanistan, Iraq, Vietnam and Israel/Lebanon. Therefore, this trend in research also respects newer dynamics of international conflict by dealing with asymmetric or hybrid state and non-state adversaries. (Griffin 2017, 201)

process are disputed. Secondly, Horowitz and Pindyck demonstrate that existing research usually treats innovation as an outcome and rarely as a process. This causes scholars to insert their research into different points of the innovation process. (Horowitz/Pindyck 2023, 85f., 97)

Innovation Diffusion

In a newer trend, the debate is advanced in the field of innovation diffusion, asking how (as opposed to whether) military innovation occurs. Most notably, in Horowitz' hypothesized *Adoption Capacity Theory*, the (a) financial intensity (resource mobilization required for adopting a military innovation) and (b) organizational capital (capacity of organizations to adapt to changes in the security environment) are the decisive factors for the successful adoption process in military organizations (Horowitz 2010, 30ff., 209). This approach omits the question of the drivers of innovation and focuses on what determines (un)successful adoption while putting emphasis on organizational factors along the process. However, the Adoption Capacity Theory drew criticism, e.g. from Gilli and Gilli (2014) who contest Horowitz' methodology and premise which assumes that organizations inherently seek adoption of novel innovation; Gilli and Gilli thereby dial back to the question of drivers of military innovation, citing tactical incentives that overtrump organizational factors when organizations make decisions about adopting technology.[9] Also, the same scholars challenge the premise that innovations spread with relative ease (Gilli/Gilli 2016, 53).

The Ecosystem Challenge

Based on this criticism, Gilli and Gilli formulate a new theory of diffusion of military innovations that addresses said shortfalls in Horowitz' theory: "the successful adoption and employment of military innovations depends on meeting the ecosystem challenge". The *Ecosystem Challenge* consists of two parts[10]: (a) A state must be capable of designing, developing and manufacturing weapon systems to meet the *platform challenge*; and (b) a state needs to be able to provide and ensure access to the necessary infrastructural and organizational support in order to meet the *adoption challenge*. (Ibid., 56) Further elaboration follows in Ch. 4.

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[9] This explanation is based on a study conducted by Kalyvas and Sánchez-Cuenca (2006). Due to Gilli and Gilli's case selection, assigning the findings to one of Grissom's schools of thought is not quite suitable because they focus on novel types of actors and warfare (terrorist actors and counterinsurgency wars) that bear significant differences to the four schools of thought that base their theory on dynamics of the traditional defense sector.

[10] It is important to note that both challenges are designed as intervening variables (cf. Beach/Pedersen 2013, 47). This differs from the terminology used in the article: Though not referring to process-tracing, Gilli and Gilli label the two challenges as *causal mechanisms*. This semantic issue is addressed by Beach and Pedersen. (cf. ibid., 57)

Interdisciplinary Approaches to Military Innovation

As mentioned above, the influence of interdisciplinary research on military innovation studies has significantly increased. For instance, the *Ecosystem Challenge* is drawn from literature on ecosystems in management (Gilli/Gilli 2016, 56). However, the role of regional and culture studies is exceedingly notable; its limitations however are pointed out by Griffin (2017) with regard to Adamsky (2010): While strategic culture may impact strategic choice, it does not prove the independent causal power of cultural factors (Griffin 2017, 204). The notion to treat the Chinese context separately from the rest of the world is widespread, especially when dealing with strategic culture.[11] This issue is a concern in this study because the case is treated within the theoretical IR debate on military innovation, not in that from China studies. Research on China's defense economy provides valuable insights into the micro level. Most notably, Cheung (2009) presents a seminal study of China's defense economy that extensively treats military innovation.[12] Moreover, research in the field of civil-military relations has similarly converged with debates in the China studies realm, a trend that traces back to early theorizations of *army-party relations* (Perlmutter/LeoGrande 1982; cf. Bitzinger 2021, Besha 2011).[13]

Another debate is observable in both IR and China studies which links the fields of military diffusion and to China's efforts to emulate military technology. Gilli and Gilli treat the case of China with regard to the theoretical debate on the increase of complexity of military technology and its impact on innovation diffusion. They argue that "China has not caught up yet" due to increasing limitations of weapon emulation. (Gilli/Gilli 2018) This argument is based on findings from Gilli and Gilli's study on the Ecosystem Challenge's applicability in the field of military diffusion (cf. Gilli/Gilli 2016, 53). Similarly, Cheung argues that innovation in China's defense industry is highly dependent on its *absorptive capacity* (Cheung 2016).

[11] The evidence contesting the concept of strategic culture, especially regarding the Chinese context, is overlooked. For instance, a lot of studies dealing with military thought in ancient China disregard relevant research that challenges the prevailing view that Chinese military thought is inherently different from that of the Western cultural context. (cf. Wilkinson 2022, 583 and Johnston, 1998) This notion is so strong that Chinese buzzwords have found their way into IR literature (cf. Horowitz/Pindyck 2023, 90: *zizhu chuangxin* 自主创新, indigenous innovation) with little consideration of their actual categorical value.

[12] Literature of this type includes, for example, Cunningham (2025), Fravel (2019) or Cheung/Mahnken (2018).

[13] Another trend reinforces this conjuncture: The relationship of the civilian and military realms are a major debate in Chinese politics. This is due to the contradictions of the centrally planned economy with the ambition of higher innovation rates in the industrial sector. Members of the party leadership have repeatedly formulated so-called Military-Civil Fusion (*junmin ronghe* 军民融合, military and civil fusion, a buzzword that ascended similar to that of *indigenous innovation*) as a strategy that is supposed to "leverage advanced commercial technologies for military modernization" (Bitzinger 2021, 6).

IV. Theoretical Framework

In order to design a causal mechanism, a theoretical foundation is needed that is suitable to examine how states successfully innovate and adopt novel military technologies. First, this requires formulating qualitative thresholds for the independent variable (X) and the dependent variable (Y); this is necessary for a causal mechanism to be present in the first place and serves as the basis of choice for picking innovations within the selected case. Second, key conceptualizations are to be made. Based on the theoretical debate on drivers of military innovation, one such driver is nested into the causal mechanism as its first part. Then, a causal theory of successful adoption of innovations is to be incorporated that then leads to the outcome. Third, scope conditions are discussed, under which the causal mechanism is expected to function.

4.1 Conceptualization

Conceptualization is conducted deductively from existing theorization (*knowledge*). Using Collier's terminology, drivers of innovation have been discussed in different schools of thought, primarily of the *theory-I* type because they were developed based on small-*n* and single case studies and entail a set of interconnected hypotheses. Horowitz' Adoption Capacity Theory is a *theory-II* type but can be considered insufficient, as argued by Gilli and Gilli's (2016). Their *Ecosystem Challenge* theory also qualifies as a *theory-II* type because it is designed as an explanatory model for the innovation of individual weapon systems and is deemed best for sustaining the causal mechanism hypothesized in this study to answer the research question.

Now, the parts of the causal mechanism are to be designed as invariable and self-contained concepts, so that they do not include the continuum in-between its positive and negative poles, making them always either present or absent. They are conceptualized as entities (nouns) engaging in activities (verbs) that thereby produce the next part of the mechanism. This approach is theory-centric because it is generalized and enables the application beyond individual cases; therefore, hypothesized causal mechanisms only include systemic parts having causal effects beyond particular cases in order to be applicable to the whole case population, making causal mechanisms rather simple and parsimonious. (Beach/Pedersen 2013, 46ff., 70; Collier 2011, 824)

4.1.1 The Independent and Dependent Variable

As this study is y-centered, military innovation is treated from the perspective of the outcome: the *successful adoption of an innovation* (Y). Therefore, the starting point (independent variable X) of the innovation process has to logically be based in *a government's interest in an innovation* (cf. Beyer 2023, 8). (1) *Innovation* (in the military context), refers to "changes in the conduct of warfare designed to increase the ability […] to generate power" (Horowitz/Pindyck 2023, 99). This is a rather broad definition that is useful for a specific reason: it is not limited to the technological development of certain weapon systems. Instead, it highlights the role of changes on the operational level of warfare. An innovation in this sense could therefore also include a shift in how a certain system is operationalized. Thus, innovation is to be understood as "a synthesis between novel technology and the doctrinal and organizational changes" (Ibid., 92). To be sure, *innovation* is only to be affirmed when a novel military innovation coincides with changes in the operational and doctrinal realms in order to reduce subjectivity. (2) *Successful adoption* directly feeds into this concept: It refers to *innovation* being observable. However, it needs to be noted that this approach limits the causal mechanism as it omits unsuccessful innovation efforts. (3) *A government's interest in an innovation* represents a leadership's assessment that the given military posture is inadequate. This can be due to external threats (revealing these inadequacies) or revolutionary innovations in weapon technology (that goad to follow suit).

4.1.2 Civilian Intervention

The core element of the civil-military model of military innovation is that of *civilian intervention*. Posen (1984) argues that the civilian leadership intervenes in military (doctrinal) innovation based on its (realist) threat perception, thereby concluding that it is civil-military dynamics that determine innovation: "Statesmen will intervene in the doctrines of their military organizations as part of an overall pattern of balancing behavior" because "of [their] fear of high costs of military action" (Posen 1984, 233). Subsequent research sustains this perspective. However, civilian intervention is only a necessary but not a sufficient cause of innovation (Grissom 2006, 908). For the purpose of this study, civilian intervention is to be incorporated as a systemic part in the first position of the causal mechanism:

$$X \rightarrow [(civilian\ intervention \rightarrow) * (n_n \rightarrow)]\ Y$$

Reducing c*ivilian intervention* into the entity-activity pattern, it can be rendered as follows: '<u>government</u> *mandates* change in doctrine'.

4.1.3 The Ecosystem Challenge

The Ecosystem Challenge is useful for answering the research questions because it treats a very similar issue (the successful adoption and employment of military innovations) and it deconstructs the innovation process into two operationalizable parts (meeting the platform and adoption challenge).

Platform Challenge

The Platform Challenge refers to the ability to innovate technology. It is relative to (a) the weapon systems' complexity (*technology*) and (b) the manufacturer's know-how (*technological capacity*).[14] This challenge is exacerbated with rising demands for specific features; the more advanced a system has to be, the higher the numbers of subsystems and components that need to be developed and integrated in the weapon system. (Gilli/Gilli 2016, 56f.)

Adoption Challenge

The Adoption Challenge relates to a set of constraints when implementing novel technology. This includes (a) organizational and (b) infrastructural requirements; (a) referring to the effective operationalization of hardware, such as doctrine, force structure, training, practices and codes and (b) including, but not limited to, logistics, communication systems and support of other weapon systems.

The Ecosystem Challenge is a theoretical framework for analyzing the likelihood of successful innovation and adoption of military technology and its diffusion in the international system. Both challenges (platform and adoption) need to be met for an innovation to be successfully adopted.[15] This design resembles that of intervening variables (Beach/Pedersen 2013, 108f.) and therefore has to be reconceptualized into a causal theory to be able to integrate it in the causal mechanism:

$$X \rightarrow \left[(n_1 \rightarrow) * \left(\begin{pmatrix} meeting\ Platform\ Challenge \\ + \\ meeting\ Adoption\ Challenge \end{pmatrix} \rightarrow \right) \right] Y$$

[14] Herein lies a benefit of this theory to the research question: As outlined in the literature review, military innovation in China is mostly treated in the context of innovation emulation; however, this approach does not differentiate between indigenous and emulated technology. It only asks for the ability to originate hardware.

[15] In practice, if a technology casts very high platform and adoption challenges, the diffusion of this technology is slow and its successful adoption is highly demanding if not unlikely. Gilli and Gilli illustrate this with the examples of the US' multilayered ICBM defense shield as opposed to the AK-47. (Gilli/Gilli 2016, 60f.)

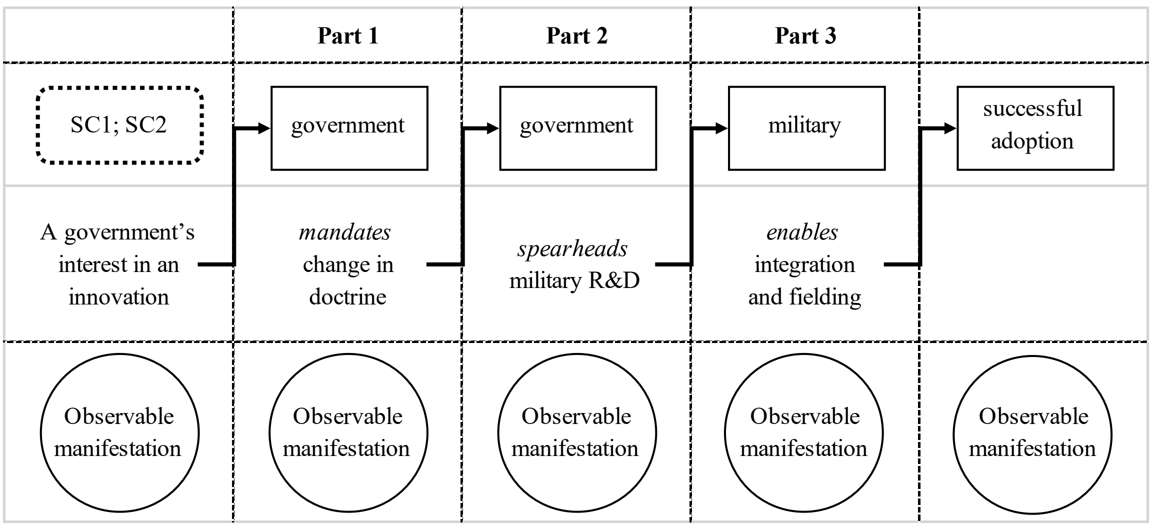
As illustrated, the differentiation of two *challenges* presents a problem here: they are in conjunction and a successional connection is not intended, say a silo for an ICBM can already be under construction while its software is still being optimized. This theoretical issue cannot be fully remedied, however, it can be said that organizational and infrastructural requirements are generally subordinated to the platform itself. In other words, meeting the platform challenge is what induces action on the level of the adoption challenge: An ICBM's (successful) innovation is what made the silo's construction necessary in the first place. This presumption is deemed sufficient for the purposes of this study. The *Ecosystem Challenge* theory can be rendered in two entity-activity patterns as follows: (a) meeting the Platform Challenge: 'government *spearheads* military R&D'; (b) meeting the Adoption Challenge: 'military *enables* integration and fielding' (by fulfilling the organizational and infrastructural requirements).

4.1.4 Scope Conditions

Scope conditions are the boundaries of applicability of the hypothesized causal mechanism; when given, the mechanism is expected to be present and to function as theorized. First (SC1), the causal mechanism is only applicable to military innovation in the traditional defense sector with top-down innovation efforts. Second (SC2), the causal mechanism is only applicable when there is a lack of a specific capability within the existing posture. This therefore excludes innovation processes that occur on a regular and planned basis such as the gradual advancements that lead to improved iterations of existing systems over time.

4.2 Building the Causal Mechanism

Figure 1: Hypothesized Causal Mechanism



own visualization (cf. Beach/Pedersen 2013, 15)

V. Case Selection

The case in a case study design for theory-testing is not supposed to stand alone; instead, the case study is intended to contribute to the understanding of the broader population of cases of the phenomenon. Theory-testing process-tracing is typically conducted after large-*n* studies found a correlation between X and Y. In such cases, selecting a *typical case*[16] is recommended because it is representative for the case population. (Beach/Pedersen 2013, 152; Gerring 2007, 91) However, in some instances, selecting a *crucial case* is advisable. A crucial case (or critical case) is "a case that offers particularly compelling evidence for, or against, a proposition". If the crucial case fits the theory, strong confidence in the theory's validity is achieved. There are two variants of crucial cases: "A *least-likely case* is one that is very unlikely to validate the predictions of a model or a hypothesis [and if valid] may be regarded as strong confirmatory evidence." A *most-likely case* is, on the other hand, "one that is very likely to validate the predictions of a model or a hypothesis." (Gerring 2007, 115, 213)

Different case selections serve different objectives. In the literature review, it was demonstrated that there already is a large body of research dealing with theories of military innovation and innovation diffusion as well as theory tests on individual weapon systems. Thus, selecting a typical case from a similar case population is unlikely to yield insightful and unfamiliar theoretical challenges to the theories; a successful detection of the causal mechanism (which would be based on theorizations developed in this context) would be highly probable. Selecting a crucial case could therefore offer more interesting observations and increase the theoretical relevance of the findings.

5.1 Case Population

Due to the abundance of case studies and theory tests, the population of *crucial* cases is rather limited. It is particularly limited when also excluding states that do not have a military-industrial sector that is innovative in itself and several studies are in dispute over the extent to which China meets this requirement. As this study seeks to examine the civil-military model of innovation, the case of China poses a least-likely case and constitutes a non-favorable setting for the theory; its political system features a dual state-party structure that has led to distinct theorizations of civil-military relations in China and the civilian and military spheres are strongly intertwined. If the hypothesized causal mechanism were to be present in a case selected from

[16] A typical case is "a case where a given causal mechanism hypothetically exists (X and Y are present) but it is neither most nor least likely" (Beach/Pedersen 2013, 182).

the Chinese context, the results would be highly beneficial (while also bearing a high risk of failing).

The case population can thus be described as all military innovation efforts in the PLA's history. Now, process-tracing can either focus on a singular *event* or on recurring *events*, however, this study's method (theory-testing process-tracing) favors recurring events in order to increase the hypothesis' generalizability and to better rule out rival explanations. This can be accounted for by either including a set of different innovations across services or successive innovations within a singular branch. In order to make different military innovation programs comparable to another, events found within the PLA's Second Artillery Corps (and later Rocket Force, PLARF) which is the service in charge of both the nuclear and conventional missile arsenal.

5.2 Missile Innovation in China, 1960-today

In order to select a case that can serve an explanatory role, the case selection and the selection of events within this case are chosen based on "descriptive characteristics [to] probe for causal relationships". (Gerring 2007, 91) The selection of China's missile innovation efforts fits this profile for several reasons. First, within the realms of this least-likely case at hand, it mitigates the risk of failure of the causal mechanism because it avoids removing the theories subjected to testing overly far away from the contexts of their formulation. As shown in the literature review, several notable studies use missile innovation and strategy (particularly in the US' context) as case studies in military innovation theory debates (cf. Grissom 2006 and footnotes 4, 5 and 6). Second, the development of missiles is less entangled with civilian innovation efforts. For instance, naval innovation is closely related to the commercial shipbuilding industry. Therefore, analyzing the innovation process of missile capabilities can be better separated from ordinary commercial R&D and thus allows for better unveiling of underlying causal relationships. Third, the development and armament of missiles is tied to a state's geopolitical risk assessments even closer than it is the case with other capabilities. This is due to the technological complexity in development and production. The enormous costs of a missile force require a state to prioritize certain capabilities over others, thus reflecting long term considerations.

In order to dissect missile innovation in China, representative events (processes of missile innovation) are to be considered in which the causal mechanism must be observable. An event is eligible when X, Y and the scope conditions are present, otherwise the whole causal mechanism cannot be present. As this may apply to a larger number of events, a choice must be made. The goal is to include both horizontal and vertical variances in the events, meaning the causal mechanism must not only be observable in different time periods but also across different types of missile systems. The missile systems to be analyzed in this study are the (a) DF-5, (b) DF-21C/D, DF-15B and the (c) CJ-10.

The DF-5 is the product of China's effort to establish a nuclear-capable ICBM. It originated from the previous missile generations DF-2 and DF-3 (MRBMs) and DF-4 (IRBM) and marked the beginning of China's intercontinental strike capability. It was liquid-fueled, silo-based and had an operational range of approximately 13,000 km. The DF-5 can be regarded as the foremost missile system of this first phase of missile innovation in China.

After the USSR's decline, China shifted to a conventional missile strategy. Making use of the M-9 and M-11 missiles which were originally produced for commercial purposes, China fielded them as DF-15 and DF-11 SRBMs as well as the DF-21 MRBM. They were solid-fueled and road-mobile but very inaccurate (300 m, 600 m and 700 m CEP[17] respectively). Following the US' intervention in Iraq (early 1990s), the Taiwan Strait crisis (1995-1996) and the Belgrade embassy bombing (1999), China saw itself confronted with a leverage deficit. This triggered a push for a larger, more accurate short and medium-range missile force with newer variants of said platforms (DF-11A and DF-15A/B/C SRBMs as well as DF-21C/D MRBMs) featuring significantly increased accuracy. These missile systems stand for this shift in strategy toward precise conventional missiles for coercive leverage and the DF-21C/D and DF-15B serve as good objects of analysis for this phase.

The development of the CJ-10 is another type of platform belonging to the same effort. The trajectory of cruise missile development in China was steep: from the first variant, the HN-1, on, the systems' range was steadily increased and the precision (likely) as well. The most prominent missile of the HN series is the third and most sophisticated variant (HN-3 which is now referred to as the CJ-10) with a very high precision (app. 5 m CEP) and a range of up to 2,000 km.

Choosing these two systems (DF-5 and CJ-10) and one group of similar systems (DF-15B and DF-21C/D) allows for testing the causal mechanism across time (vertically, 1970s/1990s/2000s) and systems (horizontally, SRBM/MRBM/ICBM).

[17] The *Circular Error Probably* (CEP) indicates a weapon system's precision. The CEP equals the radius from the aimpoint in which munitions are expected to land 50% of the time. E.g., with a CEP of 700 m and 100 munitions fired at the aimpoint, 50 are expected to land within a circle with a radius of 700 m from the aimpoint.

Figure 2: Overview of Pertinent Missile Systems in the Second Artillery, 1960s-2000s

Missile	Type	Deployment	Range	CEP
DF-2	MRBM	1964	1,250 km	*unknown*
DF-3	IRBM	1969	2,500 km	*unknown*
DF-4	IRBM	1975	< 5,500 km	1,500 m
DF-5	ICBM	1980	> 13,000 km	800 m
DF-21	MRBM	1991	< 2,150 km	700 m
DF-21A	MRBM	1996	> 1,750 km	50 m
DF-21C	MRBM	2005	2,150 km	50 m
DF-21D	MRBM	2010	1,550 km	20 m
DF-11	SRBM	1999	300 km	600 m
DF-11A	SRBM	1999	600 km	200 m
DF-15	SRBM	1993	600 km	300 m
DF-15A	SRBM	1996	850 km	45 m
DF-15B	SRBM	2009	725 km	5 m
DF-15C	SRBM	2013	800 km	*unknown*
HN-1	GLCM	1996	> 700 km	*unknown*
HN-2	GLCM	2002	1,800 km	*unknown*
HN-3 (CJ-10)	GLCM	2007	< 2,000 km	5 m

(cf. CSIS Missiles of China, 2021; Cunningham 2025, 155ff.)

Types of ballistic missiles are distinguished along their range: short-range refers to a range of 300 to 1,000 km, medium-range to 1,000 to 3,000 km, intermediate-range to 3,000 to 5,500 kilometers and intercontinental-range when exceeding 5,500 km. (Cunningham 2025, 136)

VI. Empirical Analysis

Now, the three parts of the causal mechanism are to be tested for their presence and functioning in the case of missile innovation in China, using said three systems as recurring events to focus on. This is achieved by analyzing empirical evidence for its consistency with the theorization. Evidence can be categorized by conducting four empirical tests; these tests are designed along the question whether the evidence's passing is *necessary* and/or *sufficient* for affirming the inference (Collier 2011, 825). Beach and Pedersen use a corresponding additional terminology: Evidence is *unique* when it can only relate to one theory; evidence is *certain* when its presence unequivocally proves the theory (Beach/Pedersen 2013, 101).

The four tests can be summarized as follows: (1) The *Straw-in-the-Wind* test identifies evidence which is neither necessary (certain) nor sufficient (unique) and can therefore only serve as an initial assessment of the hypothesis. While offering little inferential relevance, several straws in the wind would still qualify as valuable affirmative evidence. (2) The *Hoop* test is a necessary criterion; its failing reduces the confidence in the hypothesis and could potentially eliminate it altogether. Its passing is therefore necessary to keep the evidence under consideration but it is not sufficient to affirm the hypothesis on its own. (3) The *Smoking-Gun* test identifies evidence as sufficient but not necessary and therefore cannot affirm the hypothesis with certainty. While unique evidence may strongly support a hypothesis, its failure cannot reject it; failing to find a smoking gun is therefore little helpful. (4) The *Doubly-Decisive* test provides the strongest inferential power and its passing affirms the hypothesis while eliminating the others because it identifies evidence as both necessary (certain) and sufficient (unique). This test is obviously ideal, however, formulating predictions in this manner is challenging when dealing with the social world.[18] The general rule to be learnt here is that certainty and uniqueness of the predictions are to be maximized but certainty, the necessary condition, is to be prioritized over uniqueness. A part of the causal mechanism does not necessarily fail because of a lack of doubly decisive evidence. (Collier 2011, 825ff.; Beach/Pedersen 2013, 102ff., both based on Van Evera 1997, 31ff.)

[18] The distinctions among the four tests are not definitive and different scholars may associate evidence with different types of evidence due to varying assumptions and interpretations and differences in prior knowledge. (Collier 2011, 825f.)

For the first part of the causal mechanism, all four tests are to be conducted in order to analyze the role of civilian intervention in-depth. For the second and third part however, only the Hoop and Doubly Decisive tests are conducted. That is because in theory-testing, certainty is necessary for affirming the causal inference whereas uniqueness only indicates the level of sufficiency. Failure of the Straw-in-the-wind and Smoking-Gun tests have little implications on the hypothesis and rival hypotheses are only slightly strengthened. The passing of the Hoop test is a necessary condition for considering the evidence but insufficient to confirm the hypothesis; the passing of the Doubly Decisive test confirms the hypothesis and eliminates rival hypotheses. (Collier 2011, 825f.)

Before considering empirical evidence, the parts of the causal mechanism are to be operationalized. This is done by rendering the theoretical expectations of the causal mechanism into empirical predictions, first generalized and then case-specific, thereby determining what manifestations are required for a part of the causal mechanism to be considered present.

6.1 Civilian Intervention

Figure 3: Operationalization of Civilian Intervention in Doctrinal Development

Test	Causal Evidence	Specification	Expected Manifestations
Straw-in-the-wind	civilian officials express interest in intervening in military innovation efforts	civilian officials publicly comment on the state of military affairs and posture	CCP/CMC official refers to military capabilities necesary to acquire
Hoop	civilian officials/ institutions make adjustments to military innovation strategies	civilian officials/institutions issue concrete plans that aim to address inadequacies in military posture	CCP/CMC issues a plan to adjust military posture by adopting certain capabilities
Smoking Gun	civilian officials/ institutions allocate resources to the innovation of a specific weapon systems	civilian officials/institutions increase funds for specific capabilities	PLA receives more funds to react to inadequacies and acquire certain capabilities
Doubly Decisive	civilian officials/ institutions mandate the innovation of a specific weapon system	civilian institutions mandate the innovation of a specific capability and exert pressure to ensure this system's successful innovation	CCP/CMC requires the development of a specific weapon system and play a decisive role in the innovation process

own visualization, adapted from Collier (2011)

The first part of the causal mechanism is based on the civil-military model of military innovation. It hypothesizes that the government mandates change in the military's doctrinal development. The hypothesis can be affirmed if there is evidence that civilians and civilian institutions proactively engage in the innovation process of the DF-15/21 and CJ-10 systems and if this intervention was decisive for the success.

First, evidence for the Straw-in-the-wind test is considered. Such evidence includes (civilian) government officials expressing interest in intervening in military innovation efforts. Expected observations include public statements on the state of military affairs and on deficiencies in the PLA.

When considering the initiation of DF-5, the predominant actor shaping China's missile development program was the National Defense Science and Technology Commission (NDSTC) which sought to establish China's nuclear-armed ICBM capability; it was directly subordinate to the Central Military Commission (CMC)[19]. In 1970, (premier minister) Zhou Enlai stated at a planning meeting of the NDSTC that China "must build a certain number of a certain quality and a certain variety" but China "[does] not intend to use nuclear weapons to intimidate other and thus did not need many weapons" (as cited in Fravel 2019, 239). At that time, China was testing the DF-3 IRBM which was not only intended to enter service the year after but to also serve as an intermediate step in the process of advancing missile development, particularly for the successful developing of a nuclear-capable ICBM. This intention was reiterated by Deng Xiaoping in 1978 (shortly before becoming president): "capability should increase with each generation" (as cited in Fravel 2019, 239), not long before the DF-5's first test flight in 1980 and service entry in 1981 (CSIS DF-5, 2024).

Less convoluted than his predecessor Deng, Jiang Zemin publicly referred to military inadequacies following the Belgrade embassy bombing in 1999. At a national science and technology innovation meeting, he not only addressed needs for certain technologies such as "satellites, warning capabilities, and information support systems" but Jiang explicitly instructed the participants to "quickly acquire new *shashoujian*s [*trump cards*, implying precision conventional missiles][20] that are needed to safeguard national sovereignty and security" (as cited in

[19] The CMC is the highest leadership body of the PLA. It is both party and state organ that supervises all military activities. The CCP chairman and state president is normally also chairman of the CMC. (Heilmann 2016, 134)
[20] Cunningham does not translate the term *shashoujian* (杀手锏), trump card, in this quote in order to stress the wording used by Jiang Zemin. The term is ambiguous but most frequently used to refer to precision conventional missiles (Cunningham 2025, 69, 138).

Cunningham 2025, 166). Jiang may have alluded to the on-going development of the DF-15 and DF-21 high-precision variants or to the innovation of cruise missiles at the time.

In another instance, external incidents triggered reactions that hint civilian leaders' interest in intervening in military innovation. With the start of the Gulf War in 1991, the US successfully launched Tomahawk cruise missiles enabling very high precision strikes in Iraq. This event sparked strong reactions in Chinese media outlets referencing it in reports on the development history of the CJ-10 cruise missile. An [unspecified] member of the CCP's Central Committee was quoted saying: "We must produce this kind of missile" (Du 2013; Liu et al. 2013) despite the PLA already undertaking initial efforts for the development of a cruise missile since the 1970s (Fisher 2010, 134).

Second, evidence belonging to the Hoop test includes civilian officials issuing adjustments in military posture and innovation efforts. Expected observations include concrete plans that aim to address inadequacies in military posture.

In 1965, the Central Special Commission (CSC) set out the plan to develop 'four bombs in eight years' that outlined the steps from the DF-2 MRBM over the DF-3 IRBM, DF-4 IRBM and ultimately to the DF-5 ICBM following a conference involving more than two thousand researchers, management cadres and production experts commissioned with missile development; 1975 was set as a deadline for the development of the DF-5. This plan highlights the principal role of the CCP in driving missile innovation. Fravel contends that "top party leaders played a key role in determining the type of nuclear weapons that China should develop and how they would develop them" and argues that China's strategy and force posture were not dictated by technology; instead, the "goal of possessing a retaliatory force capable of deterring a nuclear attack guided the development of China's nuclear forces". (Fravel 2019, 256f.)

During the Taiwan Strait crisis 1995-1996, the PRC's leadership faced a leverage deficit in a limited war scenario: China did not have the coercive leverage to hamper Taiwan's first democratic election and deter the US from deploying a carrier battle group in support for Taiwan. As a response, the CMC issued a new armaments development plan in 1995. This plan stated the new prioritization of "longer-range missiles and precision guidance technology" in armament development. (Cunningham 2025, 137, 149) Jiang Zemin commented: "it is neither possible nor necessary to go and emulate everything and [to be] the same as the Western developed countries" (as cited in ibid., 150), referring to a lack of resources while facing the immediate possibility of Taiwan's secession. To be sure, the development of the DF-15A, DF-21A and

Hongniao cruise missile series (HN-1/2) were already under way before the CMC's new prioritization of precision guidance technology in missile systems at that time. They entered service around the same year. However, the plan was still relevant in affirming the innovation strategy which led to the highly successful innovation of the DF-15B, DF-21C/D ballistic and HN-3 (CJ-10) cruise missile, all of which entered service between 2006 to 2010. The three ballistic missiles (DF) feature significant improvements from their predecessors from the mid-1990s, particularly, like the plan set out, stepping up their precision. While the DF-21's precision was around 700m CEP, the C and D variants are capable of striking within 50 and 20 meters CEP respectively, an improvement by a factor of 14 and 35. Even more astonishingly, the DF-15's precision was improved by a factor of 60, from 300 to 5 meters CEP. Just like for precision-optimized ballistic missiles, the guidance systems of cruise missiles pose a significant technological challenge. Unfortunately, the precision of previous iterations of the Hongniao series before the adoption of the CJ-10 (HN-3) are unknown. The CJ-10 features a very high accuracy of 5 m CEP, similar to that of DF-15B, while being long-range capable, thereby being the missing jigsaw piece in the CMC's effort to also prioritize "longer range missiles" along with precision guidance technology. With an effective range of around 2,000 kilometers, the CJ-10 can travel more than twice the distance of the DF-15B with similarly high precision and slightly further than the DF-21 variants, all while being ground-, ship-, submarine-, and air-launchable. The examples of these four systems illustrate that the CMC's addressing of inadequacies in military posture and shift to 'longer range missiles and precision guidance technology' ultimately led to success.

Third, the Smoking Gun test is conducted. This includes civilian officials allocating resources to the innovation of a specific military capability. While being a strong indicator for civilian engagement in the innovation process, it is not certain that the civilian leadership are the principal driver behind the innovation of a specific weapon system. Expected observations include civilian institutions' involvement with specific missile systems.

In a 1986 speech, CMC member Zhang Zhen stated that "the possibility of a big nuclear war occurring is relatively small; instead, it is necessary to conduct research on campaign theory during conventional wars" (as cited in Cunningham 2025, 139). The CMC consequently adopted a plan to create conventional missile units in the same year. However, the Second Artillery was unable to field such units until pertinent missile systems were adopted by the PLA. At the time, the civilian defense sector, specifically the China Aerospace Science and Technology Corporation (CASC), was in the process of developing a missile that fit this profile:

the M-9. The CSAC's M-9 was short-range, used solid-propellant and road-mobile on transporter erector launchers. The missile was developed for export and supposed to be delivered to Syria. The commercial sale of missiles was encouraged by Deng Xiaoping after the reduction in funds for the PLA in the mid-80s threatened defense companies' existence (following the decline of the Soviet Union). Its development had only begun two years prior. With the new priorities of the PLA's leadership, the Second Artillery placed orders for the M-9 and established the first conventional missile brigade at Base 52 in 1993, equipped with the M-9 under the new designation of DF-15. (Ibid., 139ff.; Stokes 2010) Moreover, this trend was expanded in the late 1990s. Jiang Zemin's comments on precision conventional missiles at the 1999 meeting (cited in the Straw-in-the-wind test) were substantiated by the PRC Ministry of Finance which issued an increase in funds for the Second Artillery that same year. These funds enabled the Second Artillery to complete delayed projects after previously being underfunded but most importantly, to "expand its short-range conventional missile force". (Cunningham 2025, 167)

While the innovation process was initiated by the commercial interest of industrial companies, the CMC later tapped into it by allocating resources to not only order CASC's M-9 missiles to equip missile units with the now-called DF-15 but to also improve the system according to the PLA's needs. When considering the timeline and evidence on the DF-15 variants presented in the Hoop test, it is notable that the Second Artillery quickly got a hold of the much improved DF-15A and -B variants. While the Hoop displayed high certainty with regard to the general capability, the Smoking Gun here displayed the link to the industry's M-9/DF-15. In sum, the evidence still does not qualify as doubly decisive as it remains uncertain whether the civilian leadership principally drove the innovation process of the DF-15 iterations. Nonetheless, the combination of a Hoop and a Smoking Gun is a strong indication for civilian intervention.

Lastly, the Doubly Decisive test confirms the inferential relevance of evidence. This includes civilian officials mandating the innovation of a certain weapon system, thus being the unequivocal proof of civilian intervention as the sole driver of the innovation. Expected observations include decisions of the CMC to develop a specific weapon system.

In his study of China's nuclear strategy in the 1960s and 1970s, Fravel demonstrates that senior party leaders generally provide top-level guidance on the questions of force structure, citing several examples from the development of the DF-2, DF-3, DF-4 and DF-5. This guidance included top party officials directly interacting with the lead scientists of involved research institutions, thus allowing for close supervision of the development progress. In 1962, the

Politburo of the CCP established the Central Special Commission (CSC) as an organ of the Central Commission of the CCP. The following year, the CSC made the decision to prioritize ballistic missile systems as the platform of choice for its nuclear capability over other options for the operationalization of nuclear bombs (Fravel 2019, 256). This decision was followed by a statement by Zhou Enlai: "the direction of research on nuclear weapons should prioritize missile warheads, while air-dropped bombs should be secondary." (as cited in ibid., 256f.) At the time, China had only made first steps in developing the DF-2 MRBM and a launch test had just failed. Zhou's and the CSC's decision to focus on ballistic missiles systems was, at the time, unintuitive and a risk. However, it was decisive for the development of the DF-5 and also for all of China's ballistic missile innovation efforts thereafter. It also led to the establishment of the Second Artillery four years later as a unit directly under the CMC's control.

6.2 Meeting the Platform Challenge

Figure 4: Operationalization of the Platform Challenge

Test	Causal Evidence	Specification	Expected Manifestations
Hoop	civilian officials incentivize the innovation process	civilian institutions institutionalize the innovation process and create framework conditions that enable advancing military technology	CMC pools know-how and facilitates missile development
Doubly Decisive	civilian officials spearhead the innovation of a certain novel weapon system	civilian institutions create said framework conditions **and** spearhead the innovation process to lead R&D to success	CMC actively engage in the missile innovation process and exert pressure to lead it to success

own visualization, adapted from Collier (2011)

The second part of the causal mechanism is based on the Platform Challenge. It hypothesizes that the government spearheads military R&D. The hypothesis can be affirmed if there is evidence that civilians and civilian institutions proactively shape the innovation process of the DF-15B, DF-21C, DF-21D and CJ-10 systems and if this spearheading was decisive for successfully meeting the platform challenge.

First, evidence belonging to the Hoop test is considered. This includes civilian institutions creating framework conditions that enable advancing military technology. Expected observations are actions that serve the purpose of facilitating innovation. Creating framework conditions should be traceable to government institutions' initiatives.

With regard to the DF-5, Minister of National Defense Zhang Aiping commented on successful advancements in military technology innovation in 1983: “we organized […] our national defense scientific and technological units, the Academy of Science, industrial departments and higher education institutions and forces of all our provinces […] to divide up their tasks and cooperate with one another” (as cited in Frieman 1986, 66), referencing the role of the NDSTC. In 1984, Frieman discussed both issues of this cooperation as well as strategies with which military innovation processes were successfully managed up to that point. This included, first and foremost, China’s ‘indigenous R&D and production’, ‘coproduction with the USSR’, ‘reverse engineering’ among other strategies. Frieman notes that R&D assisted by the Soviets led to an overdependence and mass-production of obsolete weapons, whereas the “nuclear and satellite programs remain exceptions […] where the Chinese have designed new systems and made the transition from R&D to production entirely on their own”. She contends that the “ICBM, IRBM, and satellite programs are […] the best examples” of arms production with minimal foreign assistance, thereby referring to successful development of the DF-3, DF-4 and DF-5. However, the question remains “why certain areas, such as nuclear science, have been so successful, whereas others have been considerably less impressive”. She argues that “the evidence suggests that the nuclear program has enjoyed certain privileges denied [to] other military projects”. (Frieman 1986, 54ff.; cf. Jencks 1982, 190ff.)

The role of giving key innovation efforts certain privileges resonates with Jencks’ analysis: He contends that the platform challenge was overcome because the NDSTC still “assured maximization of China’s limited technical manpower and facilities” despite structural issues in China’s defense industry. In order to “[control] the size of the defense R&D base and the areas in which it will be expanded […], the defense industries can only build what the NDSTC allows the research academies and institutes to design and develop” by “allott[ing] the necessary funds, personnel, and flexibility.” (Jencks 1982, 203)

In 1965, the State Council “decided to assign a number of factories, research institutes, and personnel […] to accelerate cruise missile research and development” (Gormley et al. 2014). However, it was only after the US’ successful employments of the Tomahawk cruise missile in Iraq in the early 1990s that the Chinese leadership formed a new research team under the supervision of the CASIC’s Third Academy to urgently advance cruise missile development (Du 2013). At the time, the Hong Niao 1 (HN-1, China’s first generation cruise missile) had completed its first flights after almost twenty years of development. Now, with renewed pressure, the HN-1 already entered service in 1996; its much improved second generation variant (HN-

2) was first tested in 1995 and features reverse engineered technology from the Tomahawk cruise missile. It entered service in 2002. (CSIS Hong Niao 2016)

These instances display civilian institutions' involvement in innovation processes, mostly in the form of institutionalizing cooperative development efforts. However, they lack concrete proof of civilian actors principally spearheading the process of meeting the platform challenge. Only in the last example, one could argue that the Chinese leadership's renewed pressure on cruise missile development was imperative for the quick development of the CJ-10 within a few years.

Evidence that can be identified as Doubly Decisive must include said principal spearheading. Expected observations include an even closer involvement in the development of specific missile systems.

In 1998, Jiang Zemin created the new General Armaments Department (GAD) to oversee defense acquisitions. In a meeting of the GAD (which dealt with a report on the Operation Desert Fox in Iraq), CMC vice-chairman Zhang Wannian stated "[not until we] possess a set of genuinely effective *shashoujian* weapons can our country's backbone truly be hardened and can we stiffen our backs" (as cited in Cunningham 2025, 164). This quote shows that the progress in developing conventional precision missiles was not as advanced as the 1995 plan to fix the Taiwan Strait crisis leverage deficit had suggested. Soon, after the Belgrade embassy bombing, China's leaders took concrete steps in addressing this issue. At an emergency Politburo meeting in 1999, Jiang Zemin instructed the CMC to take action and close capability gaps. Jiang also decided to allocate a larger share of the national budget to defense and Zhang Wannian "gave emergency orders to the PLA to speed up the development of *shashoujian* equipment". (Ibid.) Considering the missile projects that were (as far as is publicly known) under way at the time, these orders affected the development of DF-15B, DF-21C, DF-21D, HN-2 and HN-3 (CJ-10). If Zhang interpreted the term *shashoujian* differently from Jiang, it could, because of the timeline, possibly include the development of the DF-5B, DF-31 and DF-31A as well as the DF-41, too. However, as all of these systems are ICBM projects seeking to increase China's nuclear capability's survivability, that is unlikely. Moreover, Zhang urged the CMC to "invest in important engineering projects such as the forging of *shashoujian*s" (as cited in ibid., 166) with regard to the possibility of fighting a war over Taiwan. Thus, with this intensified engagement and direct link to the weapon systems in question in this study, this piece of evidence qualifies as doubly decisive.

6.3 Meeting the Adoption Challenge

The third part of the causal mechanism is based on the Adoption Challenge. It hypothesizes that this challenge is overcome through the military's enabling of integration and fielding novel military innovations. The hypothesis can be affirmed if there is evidence that undertook actions concerning the adoption of the DF-15, DF-21 and their variants and the CJ-10 in both organization and infrastructure.

Organizational Challenges

In order to become operationalizable, hardware requires "set[ting] up appropriate codes, practices, and doctrines and […] a competent workforce organized in suitable formats" (Gilli/Gilli 2016, 59). If this is achieved, organizational challenges are overcome.

Figure 5: Operationalization of the Adoption Challenge (Organization)

Test	Causal Evidence	Specification	Expected Manifestations
Hoop	organizational configuration of the military is being advanced in line with changing posture	military actors adapt their branches' organizational structures in response to technological advancements	PLA forms new institutions that address new technologies; Second Artillery adopts new regulations integrating new missile systems
Doubly Decisive	organizational configuration of the military is being adapted to a certain novel weapon system	military actors create specialized units for weapon systems and adapt respective doctrine, codes and training	Second Artillery receives new missile units, adopts new campaign methods and conducts training exercises, all focused on a specific missile

own visualization, adapted from Collier (2011)

Evidence belonging to the Hoop test includes military actors adapting organizational structures to the military organization's reactions to technological change.

An early indicator of the organizational adaptation to the new role of missile innovation within the PLA was the Politburo's decision to establish the Central Special Commission (CSC) as an organ of the Central Committee of the CCP in 1962. It was chaired by premier and CCP vice chairman Zhou Enlai. After China's first test of an atomic device in 1964, the scope of the CSC was expanded in the following year to include more members and, crucially in this instance, "to include the development of China's ballistic missile program". (Fravel 2019, 253) Another indicator of organizational adaptation to the nuclear capability of the early missile programs leading up to the DF-5 was the design of the Second Artillery's chain of command: It was created as a unit directly under the control of the CMC, thus allowing for direct influence from top party leaders. (Ibid., 260) Generally, this accentuated role of the Second Artillery is, of course, due to its control over the nuclear arsenal. The organizational structures at the time of the successful development of the DF-5 are closely intertwined with China's nuclear strategy. This is particularly notable when regarding doctrine. As the DF-5 was the only true ICBM in China's arsenal (and thus its only means of striking US territory), it was its main weapon system for China's nuclear deterrence against the US (the previous missiles DF-2, -3 and -4 only enabled nuclear deterrence against the Soviet Union). Doctrinal adjustments were undertaken from 1975 on, particularly through its *General Combat Regulations for a Combined Army*. This text served as the PLA's operational doctrine for nuclear weapons and enshrined its no-first-use policy. This document soon led to more doctrinal texts produced by the Second Artillery which treat doctrine down to the tactical level. (Cunningham 2025, 75; Fravel 2019, 260f.)

Similarly, the adoption of the DF-15A and DF-21A in 1996 substantiated China's shift to its "local wars under high-tech conditions" strategy in the 1993 update of their main doctrinal text, the *Military Strategic Guideline*, which was "an essential step in strengthening China's conventional military capabilities over the long term." (Cunningham 2025, 90ff.)

Moreover, evidence that can be categorized as doubly decisive includes military actors adapting to novel military innovations down to the tactical level. Such expected observations include the creation of specialized units for specific missile systems, adaptation of new doctrine, codes and according new training.

In preparation for the adoption of the DF-5, both doctrine and training were adapted to the new and nuclear-capable ICBM. In the year prior to the DF-5's service entry in 1981 and following a meeting of the CCP's Central Committee and the CMC on force development of the Second Artillery, the CMC incorporated nuclear counterstrike operations into the PLA's training program for command officers (which was launched the same year) and "established the basic operational principles for the Second Artillery". (Fravel 2019, 241f.) In 1983, two years after the DF-5's entry into service, the Second Artillery conducted its first campaign-level exercise simulating a defense against a nuclear attack and launching a nuclear counter strike and served the purpose of "deepen[ing the] understanding of the operational principles" according to the commander of the Second Artillery. It emphasized the "organization, command, and coordination of protection and counterstrike operations". Learnings from this exercise were later codified in the first 'Science of Second Artillery Campaigns' in 1985. (Fravel 2019, 261f.; Godwin 1982, 36ff.)

Fast-forward, in 1993, the PLA established the first DF-15 battalion at Base 52 in Jiangxi Province. The battalion was set up by the Second Artillery in cooperation with the CASC First Academy that had also developed the DF-15 (formerly M-9). The battalion became operational in late November 1993. (Stokes 2010) However, the subsequent update to the doctrinal text of the Second Artillery (*Second Artillery Campaign Methods*) in 1996 made no mention of conventional missiles at all: "The absence of this key doctrinal component of a coercive force posture suggests that China's leaders had not yet decided to pursue a conventional missile force capable of generating coercive leverage under the shadow of a nuclear war" (Cunningham 2025, 143; cf. Fravel 2019, 264). This was catched up on when the Second Artillery drafted a formal doctrine for its conventional missile units in 1997 and issued teaching materials on a 'conventional missile strike campaign' in the same year. Conventional missile doctrine was further advanced in subsequent texts, most importantly in the 1999's *Second Artillery Conventional Missile Brigade-Battalion Combat Regulations* which would remain in place until 2020. (Ibid., 151ff.)

Moreover, in the same year, feasibility studies on the deployment of DF-21A missiles for anti-ship missions (particularly against aircraft carriers in a Taiwan-related scenario) were conducted, a process that would later feed into the development of the DF-21D. (Cunningham 2025, 151) Also, the "events across the Taiwan Strait created the opportunity for training exercises. A series of exercises were held in 1995 and 1996, including […] conventional missile exercises" (Fravel 2019, 208). This includes, crucially, the launching of ten DF-15 missiles into the Taiwan Strait. The increasing diversity in platforms within the Second Artillery was matched by its growth in size: "Four new brigades were stood up between 1980 and 2000, three of which were equipped with these latest weapons systems. This expansion accelerated in the 2000s: between 2000 and 2010, the [Second Artillery] stood up as many as eleven new brigades equipped with its growing array of weapons, including its first ground-launched cruise missile, the CJ-10, and its first road-mobile ICBM, the DF-31." (Ma 2022, 1)

Infrastructural Challenges

Figure 6: Operationalization of the Adoption Challenge (Infrastructure)

Test	Causal Evidence	Specification	Expected Manifestations
Doubly Decisive	infrastructure is being adapted to a certain novel weapon system	new infrastructure is being built to enable fielding of novel military technology	bases and infrastructure for new missile launch units are being built and other support systems are being integrated

own visualization, adapted from Collier (2011)

When the Second Artillery adopted the DF-5 in the early and mid-1980s, the Second Artillery began a large-scale construction project for the missile's launch brigades. The DF-5 measures 32.6 meters in length, making silos the only viable basing for the missile. (Fravel 2019, 260, 265) Moreover, when the Second Artillery established its first test battalion for the DF-21C at its base in Yunnan province in 2000, it formed a launch battalion, a technical battalion and a logistics team "to establish a *shashoujian* unit". It conducted a successful test launch in which the missile hit its target. (Cunningham 2025, 168)

The increase in funds for the Second Artillery following Jiang Zemins announcements on the expansion of short-range conventional missile forces in 1999 were used for two major base construction efforts for the new short-range forces. The base construction program was "intended to prepare for a large-scale conventional war". (Ibid., 167) When considering the nuclear-capable systems DF-21A, DF-15 and -15A and CJ-10, the Second Artillery optimized a lot of support capabilities from 1995 on. This includes, for example, the introduction of redundant communication links through fiber-optic networks between headquarters and bases to enable reliable communications in a war scenario as well as automated command control systems within the entire Second Artillery, thereby significantly increasing readiness. The creation of systems particularly designed to facilitate the skipping of echelons, for instance, allows a commander in the Beijing headquarters to directly give orders to a missile brigade commander in a base located several hundreds of kilometers away. (Ibid., 116f.)

By 2015, the Second Artillery fielded two to four cruise missile brigades. It is not publicly known which bases field the CJ-10 today, however, they are most likely aligned with scenarios involving the Taiwan Strait and Taiwan as well as Japan.

6.4 Assessment of Results

The empirical analysis has shown that the hypothesized causal mechanism is indeed present in the case of China's missile innovation efforts. For the first part of the causal mechanism, a combination of evidence belonging to the Hoop and Smoking-Gun tests for the DF-15/21 variants' and the CJ-10's innovation as well as doubly decisive evidence for the DF-5 were found, thus proving the presence of civilian intervention across time and systems. For the second part, evidence belonging to the Hoop test was found in the cases of the DF-5 and CJ-10 as well as doubly decisive evidence for the DF-15/21 variants and CJ-10. The causal mechanism's third part was successfully substantiated with evidence belonging to the doubly decisive tests in both organization and infrastructure, plus supplementary evidence belonging to the Hoop test of the former.

The presence of the causal mechanism proves a decisive role of the civilian sphere within military affairs. The innovation of military technologies and their adoption are directly linked to decisions made in civilian and civil-military institutions down to the level of individual weapon systems. The analysis showed how the CCP and CMC successfully ensured the meeting of the Ecosystem Challenge in the missile development of the selected systems.

VII. Conclusion

The goal of this study was to examine the presence of a hypothesized causal mechanism linking the initial interest of a government in an innovation (X) to the successful adoption of said innovation (Y). Based on existing debates in the field of military innovation, the causal mechanism served as a means of deconstructing the causal relationships between X and Y in order to shed light on the processes of China's missile innovation programs.

The empirical analysis has shown that all three parts of the mechanism were present and functioned as expected. In the first part, strong inferences about civilian intervention could be drawn, indicating the crucial role of the civilian realm in the innovation process. In the second part, the Platform Challenge was met through various measures to achieve the technological aims under the inherent constraints of technological capacity, yet again highlighting the decisive role of civilian individuals and institutions in the process. In the third part, the Adoption Challenge was met by adequate organizational and infrastructural adaptations undertaken by the Second Artillery. The Ecosystem Challenge thus adequately predicted successful innovation.

The contribution of this study is twofold: Firstly, it tested existing theory outside of the contexts of their formulation and thereby challenged the explanatory range of the theory; the theory is generalizable and can be extended to the crucial case of China. Secondly, it yielded insights into the involvement of the highest echelons of the Chinese government in military innovation processes. Most importantly though, it contributed to the debate involving a *fusion* of the civilian and military realms from an IR perspective by proving that the civilian side still retains decisive control over military innovation, even in a political system such as the Chinese. This insight weakens other explanations for the nature and origin of military innovations. Moreover, this study further substantiated Gilli and Gilli's Ecosystem Challenge theory because it also proved useful for explaining the successful adoption in a case of military innovation within the traditional defense sector.

The findings of this study entail limitations. The employed method, theory-testing process-tracing, cannot claim explanatory sufficiency within the case study; instead, it can only make statements about the presence/absence of the causal mechanism. Therefore, multiple causal mechanisms can be relevant in producing the outcome. The presented causal mechanism did correctly map causal forces contributing to producing the outcome but it cannot logically be the sole factor.

Considering the findings and limitations of this study, further research is necessary to advance the understanding of the dynamics of military innovation, its causal factors and subsequent implications for the international system.

VIII. Bibliography

Adamsky, Dima. 2010. *The Culture of Military Innovation: The Impact of Cultural Factors on the Revolution in Military Affairs in Russia, the US, and Israel*. Stanford: Stanford UP.

Armacost, Michael H. 1969. *The Politics of Weapon Innovation: The Thor-Jupiter Controversy*. New York: Columbia UP.

Bacewich, Andrew J. 1986. *The Pentomic Era: The US Army between Korea and Vietnam*. Washington DC: National Defense UP.

Beach, Derek, and Pedersen, Rasmus. 2013. *Process-tracing methods: Foundations and Guidelines*. Ann Arbor: Michigan UP.

Beard, Edmund. 1976. *Developing the ICBM: A Study in Bureaucratic Politics*. New York: Columbia UP.

Besha, Patrick. 2011. Civil-Military Integration in China: A Techno-Nationalist Approach to Development. *American Journal of Chinese Studies* 18(2): 97-111.

Beyer, Janick. 2023. *Diffusion Requirements of Military AI: How the United States are meeting the Ecosystem Challenge*. Munich: Münchener Beiträge zur Politikwissenschaft, Bachelor thesis.

Cheung, Tai Ming. 2016. Innovation in China's Defense Technology Base: Foreign Technology and Military Capabilities. *The Journal of Strategic Studies* 39(5-6): 728-761.

Coffey, Rod A. 2000. *Doctrinal Orphan or Active Partner? A History of US Army Mechanized Infantry Doctrine*. Ft. Leavenworth: US Army Command and General Staff College.

Collier, David. 2011. 'Understanding Process Tracing'. *Political Science and Politics* 4(44): 823-830.

Cote, Owen R. 1998. *The Politics of Innovative Military Doctrine: The U.S. Navy and Fleet Ballistic Missiles*. Cambridge: MIT PhD dissertation.

CSIS Missile Defense Project. 2016. 'Hong Niao Series (HN-1/-2/-3)'. *Missile Threat: CSIS Missile Defense Project*. Washington D.C.: Center for Strategic and International Studies. https://missilethreat.csis.org/missile/hong-niao/ [last modified April 23, 2024]

Cunningham, Fiona. 2025. *Under the Nuclear Shadow: China's Information-Age Weapons in International Security*. Princeton: Princeton UP.

Davis, Vincent. 1967. *The Politics of Innovation: Patterns in Navy Cases*. Denver: Denver UP.

Du, Kaiyuan. 2013. *Zhongguo Guanfang Shouci Gongkai Luji Zhanlüe Xunhang Daodan Yanzhi Shi* [China's first official disclosure of the development history of land-based strategic cruise missiles]. Shanghai: Guancha, Nov. 13, 2013. https://www.guancha.cn/military-affairs/2013_11_13_185305.shtml [retrieved June 18, 2025]

Engel, Gregory A. 1994. ‘Cruise Missiles and the Tomahawk’. In *The Politics of Naval Innovation*, eds. Bradd C. Hayes, and Douglas V. Smith. Newport: US Naval War College.

Farrell, Theo G. 1998. ‘Culture and Military Power’. *Review of International Studies* 24(3): 407-416.

Farrell, Theo G., and Terriff, Terry. 2002. *The Sources of Military Change: Norms, Politics, Technology*. Boulder: Lynne Rienner Publishers.

Fisher, Richard D., Jr. 2010. *China's Military Modernization: Building for Regional and Global Reach*. Stanford: Stanford UP.

Fravel, Taylor. 2019. *Active Defense: China's Military Strategy since 1949*. Princeton: Princeton UP.

Frieman, Wendy. 1986. ‘Foreign Technology and Chinese Modernization’. *China's Military Reforms: International and Domestic Implications*, eds. Charles D. Lovejoy, Jr., and Bruce W. Watson. Boulder: Westview Special Studies in Military Affairs.

Giese, Jon F. 1999. *Military Innovation: Sources of Change for United States Special Operations Forces*. Monterey: US Naval Postgraduate School.

Gilli, Andrea, and Gilli, Mauro. 2014. ‘The Spread of Military Innovations: Adoption Capacity Theory, Tactical Incentives, and the Case of Suicide Terrorism’. *Security Studies* 23(3): 513-547.

Gilli, Andrea, and Gilli, Mauro. 2016. ‘The Diffusion of Drone Warfare? Industrial, Organizational, and Infrastructural Constraints’. *Security Studies* 25(1): 50-84.

Gilli, Andrea, and Gilli, Mauro. 2018. Why China Has Not Caught Up Yet: Military-Technological Superiority and the Limits of Imitation, Reverse Engineering, and Cyber Espionage. *International Security* 43(3): 141-189.

Gilli, Andrea, and Gilli, Mauro. 2019. ‘Why China Has Not Caught Up Yet: Military-Technological Superiority and the Limits of Imitation, Reverse Engineering, and Cyber Espionage’. *International Security* 43(3): 141–189.

Gormley, Dennis M.; Erickson, Andrew S.; Yuan, Jingdong. 2014. A Low-Visibility Force Multiplier: Assessing China's Cruise Missile Ambitions. Washington D.C.: National Defense UP. https://inss.ndu.edu/Publications/View-Publications/Article/699509/a-low-visibility-force-multiplier-assessing-chinas-cruise-missile-ambitions/

Griffin, Stuart. 2017. ‘Military Innovation Studies: Multidisciplinary of Lacking Discipline?’. *The Journal of Strategic Studies* 40(1-2): 196-224.

Grissom, Adam. 2006. ‘The Future of Military Innovation Studies’. *Journal of Strategic Studies* 29(5): 905-934.

Heilmann, Sebastian. 2016. *Das politische System der Volksrepublik China*. Wiesbaden: Springer VS.

Horowitz, Michael C. 2010. *The Diffusion of Military Power*. Princeton: Princeton UP.

Horowitz, Michael C., and Pindyck, Shira. 2023. 'What is a military innovation and why it matters'. *The Journal of Strategic Studies* 46(1): 85-114.

Jencks, Harlan W. 1982. *From Muskets to Missiles: Politics and Professionalism in the Chinese Army, 1945-1981*. Boulder: Westview Special Studies on China and East Asia.

Johnston, Alastair I. 1998. *Cultural Realism: Strategic Culture and Grand Strategy in Chinese History*. Princeton: Princeton UP.

Kalyvas, Stathis, and Sánchez-Cuenca, Ignacio. 2006. 'Killing Without Dying: The Absence of Suicide Missions'. In *Making Sense of Suicide Missions*, ed. Diego Gambetta. Oxford: Oxford University Press.

King, Anthony. 2010. 'Understanding the Helmand Campaign: British Military Operations in Afghanistan'. *International Affairs* 86(2): 311-332.

Kollars, Nina A. 2015. 'War's Horizon: Soldier-Led Adaptation in Iraq and Vietnam'. *Journal of Strategic Studies* 38(4): 529-553.

Liu, Yidan et al. 2013. *Jiemi Zhongguo Luji Xunhang Daodan Yanfa Jianxin Licheng* [Unveiling the difficult process of China's land-based cruise missile development]. Peking: China News, Nov. 12, 2013. https://www.chinanews.com.cn/mil/2013/11-12/5494484.shtml [retrieved June 18, 2025]

Ma, Xiu. 2022. *PLA Rocket Force Organization: Executive Summary*. Montgomery: China Aerospace Studies Institute, Air University. https://www.airuniversity.af.edu/Portals/10/CASI/documents/Research/PLARF/2022-01-05%20PLARF%20Organization%20ExecSum.pdf [retrieved June 19, 2025]

Marcus, Raphael D. 2015. 'Adaptation in the Israel-Hizballah Conflict: the Institutionalization of Lesson-Learning in the IDF'. *Journal of Strategic Studies* 38(4): 500-528.

Perlmutter, Amos, and LeoGrande, William M. 1982. 'The Party in Uniform: Toward a Theory of Civil-Military Relations in Communist Political Systems'. *The American Political Science Review* 76(4): 778-789.

Pollpeter, Kevin. 2023. 'PRC Space and Missile Capabilities'. *Testimony for the US-China Economic and Security Review Commission*. Arlington: Center for Naval Analyses. https://www.cna.org/reports/2023/05/Kevin-Pollpeter-Testimony-April13-2023-on-PRC-Space-and-Missile-Capabilities.pdf [retrieved June 17, 2025]

Posen, Barry R. 1984. *The Sources of Military Doctrine: France, Britain, and Germany Between the World Wars*. Ithaca: Cornell UP.

Rosen, Stephen P. 1991. *Winning the Next War: Innovation and the Modern Military*. Ithaca: Cornell UP.

Sapolsky, Harvey M. 1972. *Polaris System Development: Bureaucratic and Programmatic Success in Government*. Cambridge: Harvard UP.

Stokes, Mark. 2010. *Beyond the Anti-Ship Ballistic Missile (ASBM): China's Next Generation Long Range Precision Strike Systems*. Arlington: Project 2049 Institute. https://project2049.net/2010/12/30/beyond-the-anti-ship-ballistic-missile-asbm-chinas-next-generation-long-range-precision-strike-systems/ [retrieved June 20, 2025]

Van Evera, Stephen. 1997. *Guide to Methods for Students of Political Science*. Ithava: Cornell UP.

Wilkinson, Endymion. 2022. *Chinese History, Volume 1: A New Manual*. Cambridge: Harvard UP.

Zisk, Kimberly M. 1993. *Engaging the Enemy: Organization Theory and Soviet Military Innovation 1955-1991*. Princeton: Princeton UP.