ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL

CONSTRUCTION PROJECT RISK MANAGEMENT UNDER CONTINGENT CIRCUMSTANCES: A CASE STUDY DURING UKRAINE-RUSSIA WAR

M.Sc. THESIS

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ISTANBUL TEKNİK ÜNİVERSİTESİ ★ LİSANSÜSTÜ EĞİTİM ENSTİTÜSÜ

OLAĞANÜSTÜ DURUMLAR ALTINDA İNŞAAT PROJESİ RİSK YÖNETİMİ: UKRAYNA-RUSYA SAVAŞI SIRASINDA ÖRNEK BİR VAKA ÇALIŞMASI

YÜKSEK LİSANS TEZİ

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Muhammed Ali ÇOLAK, a M.Sc. student of İTU Graduate School student ID 501211116, successfully defended the thesis entitled “Construction Project Under Contingent Circumstances: A Case Study During Ukraine-Russia War”, which he prepared after fulfilling the requirements specified in the associated legislations, before the jury whose signatures are below.

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To my family,

FOREWORD

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December 2025 | Muhammed Ali Çolak
(Civil Engineer)

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ABBREVIATIONS

RUB	: Rubble
EUR	: Euro
USD	: United States Dollar
NGO	: Non Govermental Organization
EPC	: Engineering, Procurment and Construction
HVAC	: Heating, Ventilation and Air Conditioning
CAD	: Computer Aided Desing
2D	: Two-dimensional space
3D	: Three-dimensional space
BIM	: Building Information Modelling
NCR	: Non-Conformance Report
IT	: Information Technology
FIDIC	: Fédération Internationale Des Ingénieurs Conseils
DAB	: Dispute Resolution Board
DAAB	: Disputr Avoidance/Adjudication Board

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CONSTRUCTION PROJECT RISK MANAGEMENT UNDER CONTINGENT CIRCUMSTANCES: A CASE STUDY DURING UKRAINE-RUSSIA WAR

SUMMARY

Construction projects implemented under contingent circumstances characterised by geopolitical instability, economic sanctions, supply chain fragmentation, and technological isolation operate within risk environments that depart substantially from conventional project settings. While traditional construction risk management frameworks assume relative stability in political, financial, and logistical conditions, such assumptions collapse when external shocks disrupt global market integration, labour mobility, and digital infrastructures. Existing literature on construction under instability has largely focused on post conflict reconstruction or projects situated within active combat zones, yet comparatively little is known about how large-scale projects continue to function when exposed to indirect but systemic conflict induced disruptions. Addressing this gap, the present study synthesizes three decades of scholarly work to develop a multidimensional typology of risks arising under contingent circumstances, categorised into political and security, supply chain, financial and contractual, operational and workforce, technological, and environmental domains. This theoretical framework is applied to an indepth case study of the Moscow Headquarters Project, an ongoing EPC development undertaken during the Russia-Ukraine conflict. Although the project was located outside the physical theatre of hostilities, it experienced profound systemic disruptions including sanctions driven procurement paralysis, currency volatility, logistical rerouting, workforce instability, and digital embargoes that disabled access to essential software ecosystems. These disruptions were further compounded by employer-initiated design changes, delayed approvals, and the emergence of claim events related to both direct and indirect cost components. Through detailed examination of project documentation, contractual processes, labour records, procurement logs, and claim dossiers, the study identifies how these layered risks materialised and evaluates the contractor’s adaptive responses. Findings reveal that successful mitigation depended heavily on

organisational resilience, global sourcing capacity, financial robustness, and the rapid development of alternative digital and logistical infrastructures. Effective strategies included early procurement, supplier diversification, internal software development, and targeted workforce stabilisation measures, whereas shortcomings emerged in pre-war procurement dependence, technological path dependency, and delayed financial adjustments.

The study demonstrates that contingent circumstances generate hybrid risk conditions that transcend traditional theories of project uncertainty, requiring adaptive, context specific, and resilience-oriented management approaches. By integrating empirical evidence with conceptual frameworks, this research offers substantive theoretical and practical contributions. It advances understanding of how conflict induced systemic disruptions reshape construction project delivery, refines risk categorisation for non-kinetic conflict environments, and provides actionable guidance for contractors operating under geopolitical and economic instability. The study ultimately underscores the growing necessity for adaptive risk management paradigms capable of withstanding globalised disruptions in contemporary construction practice.

OLAĞANÜSTÜ DURUMLAR ALTINDA İNŞAAT PROJESİ RİSK YÖNETİMİ: UKRAYNA-RUSYA SAVAŞI SIRASINDA ÖRNEK BİR VAKA ÇALIŞMASI

ÖZET

Jeopolitik istikrarsızlık, silahlı çatışmalar, ekonomik yaptırımlar, küresel tedarik zincirlerindeki kırılmalar ve teknolojik ambargolar gibi olağanüstü koşullar altında yürütülen inşaat projeleri, geleneksel proje ortamlarından köklü biçimde ayrışan risk profilleri içerisinde faaliyet göstermektedir. Klasik inşaat risk yönetimi yaklaşımları; siyasi istikrarın, finansal sistemlerin işlerliğinin, lojistik ağların sürekliliğinin ve dijital altyapıların erişilebilirliğinin varsayıldığı görece öngörülebilir ortamlara dayanmaktadır. Ancak savaş, jeopolitik kriz veya ekonomik yaptırımlar gibi dışsal şoklar bu varsayımları geçersiz kılmakta; riskler yalnızca olasılık veya etki bakımından artmakla kalmayıp, aynı zamanda niteliksel olarak da dönüşmektedir. Bu tür koşullarda inşaat projeleri; fiziksel yıkım olmaksızın dahi, küresel piyasa entegrasyonunun bozulması, işgücü hareketliliğinin kısıtlanması, finansal dalgalanmalar ve dijital ekosistemlere erişimin engellenmesi gibi sistemik aksaklıklara maruz kalmaktadır.

Mevcut akademik literatür, çatışma ortamlarında inşaat faaliyetlerini büyük ölçüde savaş sonrası yeniden yapılanma projeleri veya doğrudan aktif çatışma bölgelerinde yürütülen çalışmalar çerçevesinde ele almaktadır. Buna karşılık, fiziksel çatışma alanının dışında yer alan ancak dolaylı ve sistemik savaş etkileri altında faaliyetlerini sürdürmek zorunda kalan büyük ölçekli projelerin risk dinamikleri görece sınırlı biçimde incelenmiştir. Özellikle ekonomik yaptırımlar, finansal izolasyon, tedarik zinciri parçalanması ve teknolojik kısıtlamalar gibi "kinetik olmayan" savaş etkilerinin proje yönetimine yansımaları literatürde önemli bir boşluk oluşturmaktadır. Bu tez çalışması, söz konusu boşluğu doldurmayı amaçlayarak, olağanüstü koşullar altında yürütülen inşaat projelerinde risklerin nasıl ortaya çıktığını, nasıl etkileşim kurduğunu ve bu risklere karşı hangi uyarlanabilir yönetim stratejilerinin geliştirildiğini incelemektedir.

Bu kapsamda çalışma, ilk aşamada 1995-2024 yılları arasında yayımlanmış akademik çalışmalar, sektör raporları ve politika belgelerinin sistematik bir incelemesini gerçekleştirerek olağanüstü koşullar altında inşaat projelerini etkileyen riskleri çok boyutlu bir tipoloji çerçevesinde sınıflandırmıştır. Literatür sentezi sonucunda riskler; (i) siyasi ve güvenlik riskleri, (ii) tedarik zinciri ve lojistik riskleri, (iii) finansal ve sözleşmesel riskler, (iv) operasyonel ve işgücü riskleri, (v) teknolojik riskler ve (vi) çevresel riskler olmak üzere altı ana başlık altında toplanmıştır. Bu tipoloji, geleneksel risk sınıflandırmalarından farklı olarak, çatışma ve yaptırım koşullarında risklerin birbirini besleyen ve katmanlı yapısını ortaya koymayı amaçlamaktadır. Geliştirilen bu kavramsal çerçeve, çalışmanın ampirik bölümünde analitik temel olarak kullanılmıştır.

Tezin ampirik kısmı, Rusya-Ukrayna savaşı sırasında yürütülen Moskova Merkez Binası Projesi'nin derinlemesine bir vaka çalışmasına dayanmaktadır. Proje, fiziksel çatışma bölgesinin dışında yer almasına rağmen, uluslararası yaptırımlar, finansal dalgalanmalar ve teknolojik ambargolar nedeniyle ciddi sistemik aksaklıklar yaşamıştır. Büyük ölçekli bir Mühendislik-Tedarik-İnşaat (EPC) projesi olması, uzun süreli uygulanma dönemi ve küresel tedarik zincirlerine yüksek bağımlılığı nedeniyle bu proje, olağanüstü koşullar altında ortaya çıkan "kinetik olmayan" savaş risklerinin incelenmesi açısından kritik bir örnek teşkil etmektedir. Proje süresince yaşanan yaptırım kaynaklı tedarik felci, döviz kuru oynaklığı, lojistik güzergâhların yeniden yapılandırılması, işgücü istikrarsızlığı ve temel dijital yazılım platformlarına erişimin kesilmesi gibi gelişmeler, risklerin proje performansı üzerindeki doğrudan ve dolaylı etkilerini gözlemleme imkânı sunmuştur.

Vaka çalışması kapsamında EPC sözleşmesi ve ekleri, aylık ilerleme raporları, tedarik ve lojistik kayıtları, işgücü çizelgeleri, tasarım değişiklikleri, hak talebi dosyaları ve finansal veriler detaylı biçimde incelenmiştir. Özellikle yaptırımlar nedeniyle ortaya çıkan malzeme ikameleri, işveren kaynaklı tasarım değişiklikleri ve geciken onay süreçleri, doğrudan ve dolaylı maliyet unsurlarını içeren hak taleplerinin oluşumunu hızlandırmıştır. Bu bağlamda çalışma, FIDIC tabanlı uluslararası sözleşme uygulamaları ile Rusya Federasyonu yerel hukuk sistemi arasındaki farkların, hak talebi yönetimi üzerindeki etkilerini de irdelemiştir. Bulgular, risklerin yalnızca teknik veya finansal sorunlar yaratmadığını; aynı zamanda sözleşmesel, yönetsel ve kurumsal süreçleri de yeniden şekillendirdiğini ortaya koymaktadır.

Elde edilen bulgular, olağanüstü koşullar altında risklerin etkin biçimde yönetilebilmesinin büyük ölçüde yüklenicinin örgütsel dayanıklılığına ve uyarlanabilir kapasitesine bağlı olduğunu göstermektedir. Erken tedarik stratejileri, tedarikçi çeşitlendirmesi, alternatif lojistik güzergâhların geliştirilmesi, kurum içi yazılım çözümlerinin üretilmesi ve işgücünün korunmasına yönelik hedefli önlemler, projenin sürekliliğinin sağlanmasında belirleyici rol oynamıştır. Buna karşılık, savaş öncesi dönemde belirli tedarikçilere ve yazılım ekosistemlerine aşırı bağımlılık, finansal uyum mekanizmalarının gecikmeli devreye alınması ve teknolojik yol bağımlılığı gibi unsurlar, risklerin etkisini artıran zayıflık alanları olarak öne çıkmıştır.

Çalışma, olağanüstü koşulların geleneksel proje belirsizliği kavramının ötesinde, hibrit ve sistemik risk ortamları yarattığını ortaya koymaktadır. Bu tür ortamlarda risk yönetimi, yalnızca olasılık temelli yaklaşımlarla değil; bağlama özgü, esnek ve dayanıklılık odaklı yönetim paradigmalarıyla ele alınmalıdır. Tez, ampirik bulgular ile kavramsal çerçeveleri bütünleştirerek hem teorik hem de pratik açıdan önemli katkılar sunmaktadır. Çatışma kaynaklı sistemik aksaklıkların inşaat proje teslim süreçlerini nasıl dönüştürdüğüne dair anlayışı derinleştirmekte, kinetik olmayan çatışma ortamları için risk sınıflandırmasını geliştirmekte ve jeopolitik ve ekonomik istikrarsızlık altında faaliyet gösteren yükleniciler için uygulanabilir yönetim önerileri sunmaktadır. Sonuç olarak bu çalışma, günümüzün küreselleşmiş ve kırılgan proje ortamlarında, uyarlanabilir risk yönetimi yaklaşımlarının giderek artan önemini vurgulamaktadır.

1. INTRODUCTION

The construction industry routinely operates under conditions of uncertainty, yet traditional risk management frameworks presuppose a baseline of political stability, predictable supply chains, functioning financial markets, and reliable technological infrastructure. Under contingent circumstances such as war, geopolitical crises, economic sanctions, regime instability, or large-scale security disturbances these assumptions collapse. Such environments do not merely elevate the probability or impact of known risks; rather, they introduce new categories of systemic risk that fundamentally alter how projects must be conceived, planned, and executed. As recent conflicts across Afghanistan, Iraq, Syria, Yemen, and Ukraine have demonstrated, construction sector risks under instability extend far beyond cost overruns and schedule delays, encompassing workforce displacement, institutional fragmentation, supply chain collapse, macroeconomic volatility, and technological isolation. Existing scholarship has increasingly recognized these complexities, yet the literature remains heavily weighted toward post conflict reconstruction. Far less attention has been given to projects that continue during conflict without experiencing physical destruction, but which nonetheless face profound disruptions through sanctions, regulatory fragmentation, currency instability, and technology embargoes. These contingent environments present a distinct analytical challenge: they expose projects to hybrid forms of risk that are political, economic, technological, and organizational in nature, intersecting in ways that conventional project management theories do not fully capture.

Responding to this research gap, the present study undertakes a dual methodological approach. First, it synthesizes the extensive literature on risk in conflict affected construction environments and develops a structured risk typology across six domains: political and security, supply chain, financial and contractual, operational and workforce, technological, and environmental. This classification establishes a theoretical baseline for understanding how risk profiles transform when geopolitical instability interrupts global market integration, digital infrastructures, and labour mobility. The study applies this framework to a detailed case analysis of the Moscow Headquarters Project a large-scale engineering, procurement, and construction (EPC) undertaking executed during the Russia–Ukraine conflict. Despite its location outside the combat zone, the project encountered systemic disruptions including sanctions driven procurement paralysis, currency shocks, workforce instability, logistical rerouting, and the sudden loss of access to critical digital platforms. These disruptions were further compounded by employer driven design changes and the resulting need for formal claim procedures involving both direct and indirect cost components. The project therefore offers a unique empirical context for examining how large contractors navigate multilayered risks when traditional operational structures are constrained. The introduction of claim processes, material substitution strategies, workforce retention measures, and internally developed technological solutions provides insight into the contractor's organizational resilience and adaptive capacity. Evaluating the effectiveness of these interventions enables a deeper understanding of not only how risks were managed, but why certain strategies succeeded while others fell short. In doing so, the study contributes to a more nuanced conceptualization of project resilienceone that accounts for financial robustness, local sourcing strategies, institutional alignment, and the contractor's global operational capacities. Ultimately, this research positions contingent circumstances as a critical domain within construction management scholarship. It demonstrates that conflicts increasingly reshape project environments through mechanisms other than physical destruction, particularly through economic decoupling, technological restrictions, and institutional volatility. By integrating theoretical perspectives with empirical evidence, the study aims to advance risk management frameworks that are both adaptive and context specific, offering guidance for practitioners operating in environments where geopolitical dynamics increasingly dictate project outcomes.

2. LITERATURE REVIEW

This chapter reviews the existing literature on construction project risk management, with particular emphasis on how risk frameworks evolve under contingent circumstances such as armed conflict and geopolitical instability. The discussion begins with an overview of general risk management principles in construction projects, before narrowing its focus to projects executed under wartime and conflict-affected conditions. Subsequently, the chapter examines the theoretical foundations, risk categories, assessment methodologies, and mitigation strategies identified in the literature, providing a structured basis for the empirical analysis presented in later chapters.

2.1 General Risk Management in Construction

Risk management has long been recognized as a central component of construction project success. The industry is inherently exposed to uncertainties ranging from cost escalation, design changes, and supply delays to health and safety concerns (Akintoye, 1997; El-Sayegh, 2008). Established frameworks emphasize the identification, allocation, and mitigation of risks across the project lifecycle (Fayek, 2012). Research also highlights the significance of political, financial, and environmental factors in shaping project outcomes. While such studies provide robust foundations for generic risk management, most do not consider the added complexity of wartime or conflict environments, where risks intensify due to instability, infrastructure destruction, and security threats.

2.2 Construction Projects Under Contingent Circumstances

Construction project risk management under wartime conditions represents a critical area of study that extends traditional project risk theory into the complex domain of conflict affected environments. The literature reveals that war conditions fundamentally alter the risk landscape for construction projects, creating unique challenges in both financial management and time scheduling that require specialized theoretical frameworks and practical approaches (Ahmadzai, 2024; Hansen, 2024). This literature review examines the current state of research on construction project risk management under war conditions, with particular focus on financial risks and time extension challenges.

The literature on construction in war affected contexts has expanded in recent years, particularly in Afghanistan, Iraq, Syria, Yemen, and Ukraine. Several studies highlight that armed conflict introduces not only traditional risks such as cost overruns and labour shortages but also unique risks including infrastructure collapse, sanctions, and security driven site shutdowns. Reports that Afghanistan's construction sector faced severe challenges in maintaining supply chains and labour availability during wartime (Liu, 2023). Similarly, Ivanova (2024) and Skrynkovskyy (2023) examine Ukraine's construction industry under martial law, finding that transportation bottlenecks, disrupted supply chains, and material scarcity were major obstacles. Lyubchenko (Lyubchenko, 2023) further emphasize the urgency of emergency restoration work for buildings damaged by bombardments, where hazardous rubble complicates environmental safety.

Beyond supply and operational concerns, contractual and governance issues are also documented. Hansen (Hansen, 2024) analyse how force majeure clauses, war exclusions in insurance, and the role of military civilian collabouration influence project execution. In counterinsurgency contexts, (Hodiamont, 2010) describes how military involvement in Afghanistan's reconstruction blurred the lines between civil engineering management and security imperatives. Post-war reconstruction research also underscores the trade off between sustainability and speed. Khaddour (2023) demonstrate that sustainability goals in Syria's reconstruction are often compromised due to the urgency of housing delivery. Papirnyk (2024) identify innovative technologies used under "special conditions," yet note that their application remains constrained by unstable environments. In parallel, U.S. Congressional reports on military construction in Afghanistan and Iraq highlight the scale and cost of wartime infrastructure programs, further illustrating how geopolitical conditions shape project outcomes (Senić, 2024).

Building upon this body of literature, it becomes necessary to clarify what is meant by contingent circumstances within the context of construction project risk management. In this study, contingent circumstances are understood as extraordinary, externally driven conditions that fundamentally disrupt the normal assumptions of project planning, execution, and control. These circumstances encompass a broad spectrum of events, including armed conflicts and wars, large-scale natural disasters such as earthquakes, floods, and hurricanes, pandemics and major public health crises, severe economic shocks and financial collapses, periods of political instability and regime change, as well as disruptive technological shifts and restrictions. In addition, the accelerating impacts of climate change increasingly function as contingent conditions by amplifying uncertainty, stressing infrastructure systems, and altering regulatory and environmental constraints. Collectively, these factors redefine the operational environment of construction projects, transforming risk from a predominantly technical concern into a multidimensional phenomenon shaped by political, economic, social, and technological forces.

2.3 Theoretical Foundations and Conceptual Frameworks: Risk Theory in Conflict Contexts-Cost Overruns

The theoretical foundations for understanding construction risks under war conditions build upon general project risk management theory but emphasize conflict specific drivers that invalidate normal assumptions about probability distributions, market stability, and institutional continuity (Razia, 2019). Traditional risk management models assume relatively stable operating environments, but war conditions introduce what researchers term "deep uncertainty" where probability distributions become unreliable and standard risk assessment methodologies may fail. Hansen (2024) provides a comprehensive analysis of contractual theory applications in wartime construction, emphasizing the centrality of force majeure clauses and war specific contract provisions for allocating conflict related contingencies. The research demonstrates that standard construction contracts often inadequately address the unique risks posed by active conflict, necessitating specialized contractual frameworks that can accommodate extreme uncertainty and rapid environmental changes.

Recent studies have integrated stakeholder theory and psychometric risk perception models to better understand how construction risks are perceived and managed in conflict zones (Rashid, 2016). These frameworks recognize that risk assessment in war conditions cannot rely solely on quantitative models but must incorporate cultural, social, and psychological factors that influence stakeholder behavior and decision making under extreme stress.

The literature also emphasizes the importance of tactical project management approaches that shift from strategic, long horizon planning to adaptive, short cycle management systems (Kobylkin, 2023). This theoretical shift reflects the need for construction projects to maintain operational flexibility and safety during rapidly changing wartime conditions.

Financial risks in construction projects under war conditions manifest through multiple interconnected channels that amplify traditional cost management challenges. The empirical literature consistently identifies several key financial risk categories that demonstrate significantly higher probability and impact in conflict environments compared to peacetime construction. Direct security related costs represent a primary source of financial exposure, encompassing damage repairs, material losses, and protective security measures. Ahmadzai (Ahmadzai, 2024), demonstrate through quantitative modelling that security related delay factors, including local armed interference and evacuation requirements, constitute high severity contributors to cost escalation in Afghanistan construction projects. Their analysis reveals that security costs can increase project budgets by 15-30% beyond normal contingency allowances.

Currency fluctuation and macroeconomic instability emerge as consistently high ranking financial risks across multiple conflict affected regions. Identified currency fluctuation as a primary economic risk factor in Lebanese construction projects, while (Oriekhova, 2024) documents similar patterns in Ukrainian construction during wartime conditions. The literature indicates that currency devaluation can occur rapidly and unpredictably during conflicts, creating substantial financial exposure for projects with extended durations or significant imported material components.

Funding disruptions represent another critical category of financial risk, manifesting as delayed progress payments, unavailability of funds, and project suspension risks. (Choudhry, 2014) The Rank unavailability of funds as the highest priority financial risk affecting both cost and schedule performance in bridge construction projects in conflict affected regions. Their empirical analysis demonstrates that funding interruptions create cascading effects that amplify other risk categories and significantly increase total project costs.

Noorzai (2021) provides detailed analysis of public private partnership financial risks in conflict zones, identifying unique financing challenges that emerge when traditional capital markets become disrupted or inaccessible. The research reveals that private sector participation in construction projects becomes severely constrained under war conditions, necessitating alternative financing mechanisms and risk sharing arrangements.

Insurance and risk transfer mechanisms face particular challenges in war affected construction environments. The literature documents widespread market failures where standard commercial insurance becomes unavailable or prohibitively expensive (Schreiber, 2021). Military risk insurance markets often fail to provide adequate coverage for construction activities, creating significant financial exposure for project stakeholders.

Oriekhova (2024) examine energy sector construction projects during wartime and recommend specialized military risk insurance mechanisms combined with international finan cing partnerships to maintain project viability. Their analysis suggests that traditional insurance models require fundamental restructuring to address the unique risk profiles of wartime construction.

2.4 Risk Theory in Conflict Contexts: Time Extension and Schedule Risk Analysis

To understand the main objectives of this thesis, it is necessary to consider the theoretical foundations and conceptual framework, which should firstly address time extension and construction project schedule delay risks. Time related risks in construction projects under war conditions operate through multiple interconnected mechanisms that create both direct delays and systemic schedule uncertainties. The literature identifies several key pathways through which conflict conditions impact project duration and scheduling reliability. Movement restrictions and security protocols represent primary drivers of schedule disruption. Papirnyk (2024) document how security requirements create systematic delays in material delivery, workforce mobility, and inspection processes in Yemen construction projects. Their empirical analysis reveals that security related delays can extend project durations by 25-50% beyond baseline schedules. Supply chain disruptions constitute another major source of schedule risk, as war conditions frequently interrupt normal procurement and delivery systems. Mohammad (2015) analyses construction project management in terrorism affected areas and identify supply chain vulnerability as a critical factor in schedule performance. The research demonstrates that projects with longer supply chains and greater dependence on imported materials face exponentially higher schedule risks.

Project suspension and restart cycles create particular challenges for schedule management in war conditions. Demirci (2025) provides comprehensive analysis of suspension risks in public infrastructure projects, identifying the complex financial and scheduling implications of temporary project halts. Their research reveals that suspension events create nonlinear schedule impacts, where restart delays often exceed the duration of the suspension period itself. The literature emphasizes that suspension risks are particularly acute in conflict environments where security conditions can change rapidly and unpredictably. Projects must maintain capability for rapid shutdown and restart, which requires specialized planning approaches and resource management strategies.

Human resource availability represents a critical constraint on schedule performance in war-affected construction projects. Anwar (2019) examine the effects of varying factors on construction project performance in terrorism-affected areas, identifying workforce availability and skill retention as primary schedule risk factors. The research demonstrates that conflict conditions create systematic workforce disruptions through evacuation requirements, security concerns, and broader economic displacement. The literature also documents significant challenges in maintaining technical expertise and specialized skills during extended conflict periods. Projects often face degraded capability in critical technical areas, necessitating alternative approaches to maintain schedule performance.

2.5 Risk Assessment Methodologies and Mitigation Techniques appropriate for Contingent Circumstances

The literature presents various quantitative methodologies for assessing construction risks under war conditions, though researchers emphasize that traditional probabilistic models require significant adaptation for conflict environments. Sonmez (2007) developped quantitative methodology for cost contingency determination in international projects, providing frameworks that can be adapted for conflict specific risk assessment.

Senić (2024) advanced the field through development of fuzzy logic models for risk quantification in road infrastructure projects. Their Sugeno model approach provides improved prediction accuracy for extension of time and contract price increases, demonstrating the value of hybrid quantitative qualitative assessment methods in uncertain environments.

Monte Carlo simulation approaches receive extensive attention in the literature as tools for probabilistic risk assessment. Choudhry (2014) demonstrate the application of Monte Carlo methods for cost and schedule risk analysis, though they emphasize the need for careful parameter estimation in conflict environments where historical data may be limited or unreliable.

Qualitative risk assessment approaches gain particular importance in war conditions where quantitative data may be scarce or unreliable. Rashid (2016) developed stakeholder informed frameworks that capture context specific risk perceptions and implementation constraints in conflict zones. These approaches enable prioritization of movement restrictions, policy implementation failures, and resource availability risks that may not be adequately captured through quantitative methods alone.

The literature emphasizes the importance of integrating local knowledge and cultural understanding into risk assessment processes. Stakeholder engagement approaches must account for the complex social and political dynamics that influence risk perception and management in conflict affected environments.

2.6 Risk Mitigation Strategies

Contractual risk mitigation strategies receive extensive attention in the literature, with researchers emphasizing the critical importance of precise force majeure and suspension clause drafting. Hansen (2024) provides detailed analysis of contractual implications, demonstrating that standard construction contracts often inadequately address war related risks and require specialized provisions for notification procedures, risk allocation, and dispute resolution.

The literature consistently recommends transparent payment mechanisms and escrow arrangements to address liquidity risks and delayed progress payments. These contractual tools help maintain project cash flow and reduce financial exposure for both owners and contractors in uncertain environments.

Financial risk mitigation strategies encompass specialized insurance arrangements, currency hedging mechanisms, and alternative financing structures. The literature recommends dedicated military risk insurance programs combined with international donor guarantees to mobilize private capital for construction projects in conflict zones (Schreiber, 2021).

Currency hedging and dynamic financial planning approaches receive particular attention as tools for managing macroeconomic risks. Sytnyk (2024) examine financial security strategies under war conditions and recommend adaptive budgeting systems that can accommodate rapid changes in economic conditions. Operational risk mitigation strategies emphasize tactical project management approaches that prioritize adaptability and rapid response capability. The literature recommends shortened planning cycles, frequent re planning processes, and redundant communication systems to maintain project continuity under military threats (Kuz′mych, 2024). Modular construction approaches and local sourcing strategies receive attention as methods for reducing supply chain vulnerability. Where feasible, increased local procurement and prefabrication can reduce exposure to long supply lines that are vulnerable to disruption during conflicts.

2.7 Summary of Identified Risks in Wartime Construction Projects

Synthesizing across these studies, several categories of risks emerge in construction under war conditions:

- Political & Security Risks - regime changes, armed attacks, sabotage, insurgency (Ahmadzai, 2024).
- Supply Chain Risks - damaged logistics infrastructure, material shortages, price inflation (Ivanova, 2024; Skrynkovskyy, 2022).
- Financial & Contractual Risks - inflation, investor withdrawal, insurance exclusions, disputes over force majeure (Hansen, 2024; Kremers, 2010)
- Operational & Workforce Risks - labour migration, displacement, site shutdowns due to curfews or security measures (Hodiamont, 2010; Lyubchenko, 2023)

- Technological Risks weak digital infrastructure, BIM disruptions under unstable networks (Kassem, 2019; Papirnyk, 2024)
- Environmental Risks hazardous rubble, toxic debris, sustainability trade-offs (Khaddour, Lyubchenko, 2023)

The literature collectively suggests that wartime construction risks extend beyond traditional project management concerns. Whereas generic risks focus on cost, time, and quality, conflict-driven risks add layers of political, security, and environmental uncertainty. Studies converge on the view that resilience, adaptability, and context-specific frameworks are essential for managing projects under such conditions. Figure 2.1 summarises the principal construction risk categories derived from the literature review.

Figure 2.1 : Risk definitions in literature reviews.

2.8 Comparative Analysis: War-Time vs. Post-War Risks

The comparative analysis of construction project risks across wartime and post-war phases reveals a fundamental transformation in risk priorities, reflecting the distinct operational environments and strategic challenges inherent to each phase. This shift is not merely a matter of degree but represents a qualitative change in threats facing construction projects. During active warfare, risks are predominantly tactical, immediate, and externally imposed, characterized by physical threats, supply chain collapse, and operational disruptions that demand real-time adaptive responses. In contrast, post-war reconstruction phases witness a strategic reorientation toward systemic, institutional, and capacity-related risks that, while more predictable, are deeply embedded in the socio-political and economic fabric of recovering societies.

The literature consistently demonstrates that risk management frameworks developed for stable environments prove inadequate when applied to conflict affected contexts, and furthermore, that frameworks appropriate for war-time construction require substantial recalibration for post-war reconstruction (Abdulrahman, 2019; Ahmad, 2023; Kobylkin, 2023). This section synthesizes findings spanning conflict zones including Afghanistan, Iraq, Syria, Yemen, Gaza, Sri Lanka, and Ukraine to establish evidence-based risk priority rankings for both phases and to elucidate the mechanisms driving priority shifts during the transition from active conflict to reconstruction. A comparative summary of risk priorities across war-time and post-war phases is presented in Table 2.1.

Table 2.1 : Comparisons of the concept of risk Post-war and war-time.

Risk Category	War-Time	Post-War
Security & Safety	Critical	Moderate
Supply Chain & Logistics	Critical	High
Financial & Economic	Critical	High
Operational & Workforce	High	Moderate -High
Governance & Institutional	Moderate -Low	Critical
Infrastructure Deficit	High	Critical
Technical Capacity & Standards	Moderate	High
Social & Community	Moderate - Low	High
Technological	Moderate - High	Moderate
Environmental	Moderate	Moderate

2.8.1 Security and safety risks

During active warfare, security and safety risks consistently emerge as the dominant concern across all conflict contexts examined in the literature. Mohammad et al. (2015) identified security threats as the highestranked risk factor in their study of construction projects in terrorism affected areas of Afghanistan, where physical attacks, theft, and personnel safety concerns directly caused project delays and cost escalations. Similarly, demonstrated through structural equation modelling that security related factors were the primary drivers of construction delays in Afghanistan, with direct attacks on sites, material theft, and movement restrictions creating cascading effects throughout project schedules. Alashwal (2019) documented comparable findings in Yemen during the unrest period, where security risks ranked highest among all risk categories affecting construction projects.

The immediate physical threat to personnel, equipment, and materials during active conflict creates an environment where construction activities can be halted instantly by security incidents. Schuldt et al. (2020) developed optimization models specifically for minimizing consequences of explosive attacks on remote construction sites, highlighting the need for specialized risk mitigation strategies including site fortification, security personnel deployment, and blast resistant temporary structures. Their research demonstrated that security related costs could account for 15-25% of total project budgets in high threat environments, representing a substantial financial burden that fundamentally alters project economics.

Schreiber et al. (2021) analysed the impact of military factors and security threats on construction projects in Baghdad, finding that security incidents not only caused direct damage but also created psychological barriers that reduced workforce productivity, increased insurance premiums, and deterred contractor participation. The study revealed that projects in high security risk zones experienced 40-60% longer durations compared to similar projects in stable regions, with security-related delays accounting for the majority of schedule overruns.

The transition to post war conditions witnesses a dramatic reduction in acute security threats as active hostilities cease and territorial control stabilizes. Mitoulis et al. (2023) developed a conflict resilience framework for critical infrastructure that explicitly recognizes the declining priority of security risks during reconstruction phases, noting that while residual threats persist, they no longer dominate project planning. The framework emphasizes that post war security concerns shift from preventing direct attacks to managing residual explosive remnants of war, addressing localized instability, and establishing secure supply routes.

However, the literature cautions against premature security demobilization. Ye (2019) noted that in Afghanistan's reconstruction period, residual security threats continued to impact projects for years after formal conflict cessation, particularly in rural areas where governance remained weak. The research indicates that security risk reduction follows a gradual trajectory rather than an immediate shift, with the transition period requiring careful monitoring of security indicators and flexible response strategies.

The downgrading of security risks from critical to moderate in post war phases reflects both the actual reduction in threat levels and the emergence of other priorities that compete for management attention and resources. As governance structures stabilize and reconstruction gains momentum, project managers can redirect resources previously allocated to security toward addressing institutional weaknesses, capacity gaps, and infrastructure deficits that become more salient in the reconstruction environment.

2.8.2 Supply chain and logistics risks

Supply chain disruption emerges as one of the most pervasive and persistent challenges during active warfare. Affleck et al. (2011) documented extensive lessons learned in Afghanistan concerning design and construction challenges, identifying supply chain constraints as a fundamental limiting factor for project execution. Their research revealed that material procurement lead times increased by 200-400% compared to peacetime conditions, with many specialized materials becoming entirely unavailable due to transportation route closures, border restrictions, and supplier withdrawal from conflict zones.

The war-time supply chain crisis manifests across multiple dimensions. Physical infrastructure damage including roads, bridges, ports, and airports severely constrains transportation capacity and increases delivery costs. Alashwal and Al-Sabahi found that in Yemen, logistics costs for construction materials increased by 150-300% during the unrest period due to damaged infrastructure, circuitous routing requirements, and security convoy necessities. The research demonstrated that projects frequently experienced material shortages that halted construction activities, with some projects reporting material delivery delays of 6-12 months beyond planned schedules.

International sanctions, trade restrictions, and banking system disruptions further compound supply chain challenges during warfare. Materials that require international procurement face additional barriers including currency instability, payment processing difficulties, and export control regulations. The literature indicates that projects increasingly rely on local materials and suppliers during warfare, but local production capacity is often simultaneously degraded by conflict, creating a supply demand imbalance that drives price inflation and quality compromises.

Workforce mobility restrictions represent another critical supply chain dimension. Security checkpoints, curfews, and territorial fragmentation impede the movement of skilled labor to project sites. Projects in divided territories face particular challenges when workforce populations are separated from construction sites by front lines or security zones, forcing reliance on locally available labor that may lack required skills and experience.

The post-war period witnesses gradual supply chain recovery, but significant challenges persist. Infrastructure reconstruction enables improved transportation networks, but restoration occurs incrementally over years. Early reconstruction projects face continued supply chain constraints as infrastructure repair itself requires material procurement through degraded logistics networks, creating a circular dependency. The literature indicates that supply chain risks remain elevated in post-war contexts due to several persistent factors. Reconstruction demand surges create temporary supply shortages as material consumption rapidly increases beyond pre-war levels. Local production capacity requires time to rebuild, and international suppliers remain cautious about entering recently conflict affected markets due to perceived instability and payment risks.

However, supply chain risks transition from critical to high priority as transportation infrastructure gradually recovers, banking systems stabilize, and international trade relationships normalize. The research suggests that supply chain normalization typically requires 3-5 years in post-war contexts, with timeline variations depending on conflict severity, infrastructure damage extent, and international reconstruction support levels.

2.8.3 Financial and economic risks

Financial risks during warfare reach critical levels due to multiple converging factors. Currency instability, banking system disruption, and economic collapse create an environment of extreme financial uncertainty. Alashwal and Al-Sabahi documented that in Yemen, currency devaluation during the unrest period caused project costs to increase by 80-200% compared to initial budgets, with some projects becoming financially unviable midexecution.

Access to project financing becomes severely constrained during warfare. International lenders withdraw from conflict zones, domestic banking systems face liquidity crises, and traditional financing mechanisms collapse. Projects increasingly rely on cash transactions and informal financial networks, which introduce additional risks including theft, corruption, and lack of financial controls.

Cost estimation accuracy deteriorates dramatically during warfare due to rapid price fluctuations, supply chain unpredictability, and security cost uncertainties. The literature indicates that contingency allowances of 30-50% are common for war-time construction projects, compared to 5-15% in stable environments, yet even these elevated contingencies frequently prove insufficient.

Financial risks persist at high levels during post-war reconstruction despite conflict cessation. Kropelnytska et al. (2023) analysed risk management of reconstruction projects in Ukraine, finding that financial risks remained among the top concerns due to continued economic instability, currency volatility, and reconstruction funding uncertainties.

Post-war financial challenges include reconstruction funding gaps, as the scale of rebuilding needs typically far exceeds available resources. International donor funding provides critical support but introduces dependencies and conditionalities that create new financial risks. Domestic revenue generation remains constrained by economic damage, creating fiscal pressures that affect public sector construction projects.

Banking system recovery occurs gradually, and access to construction financing remains limited in early reconstruction phases. Insurance markets are slow to return to post-conflict environments, forcing projects to self insure or operate without coverage for major risks. The literature indicates that financial risk normalization requires sustained economic stability over 5-10 years, making financial considerations a persistent high priority throughout the reconstruction period.

2.8.4 Operational and workforce risks

Operational risks during warfare stem from workforce disruptions, management challenges, and operational environment instability. Ahmadzai and Ye found that workforce related factors were significant contributors to construction delays in Afghanistan, including skilled labor shortages, workforce displacement, and productivity reductions due to security concerns and psychological stress.

The war-time operational environment creates unique management challenges. Traditional project management methodologies prove inadequate for the extreme uncertainty and rapid change characteristic of conflict zones. Communication systems may be disrupted, decision making hierarchies become unclear as personnel relocate, and coordination between project stakeholders deteriorates.

Workforce availability fluctuates dramatically as conflict conditions change. Military conscription removes workers from the labor pool, displacement separates workers from project sites, and security concerns cause workers to avoid high-risk areas. The literature indicates that workforce turnover rates in war-time construction projects can reach 40-60% annually, compared to 10-20% in stable environments, creating continuity challenges and productivity losses.

Operational risks persist at moderate-high levels during reconstruction as workforce challenges continue. Seneviratne et al. examined post-conflict housing reconstruction in Sri Lanka, identifying workforce capacity gaps as a persistent constraint. The research found that conflict related brain draining, skills attrition during warfare, and training system disruption created lasting workforce deficits that constrained reconstruction pace.

However, operational conditions gradually stabilize during post-war periods. Communication systems recover, management structures normalize, and operational predictability improves. The research indicates that operational risk levels remain elevated compared to peacetime but decline from war-time peaks as reconstruction progresses and institutional capacity rebuilds.

2.8.5 Governance and institutional risks

During active warfare, governance and institutional risks, while present, receive relatively low priority in project risk assessments. The immediate demands of security, supply chain, and financial crises overshadow institutional concerns. Projects operate in survival mode, focusing on immediate tactical challenges rather than institutional frameworks.

Governance structures often collapse or fragment during warfare, but this institutional vacuum paradoxically reduces governance related project risks in the short term. With weakened regulatory enforcement, simplified approval processes, and emergency authorities, projects face fewer bureaucratic barriers. However, this institutional weakness stores up significant problems for the post-war period.

The post-war period witnesses a dramatic elevation of governance and institutional risks to critical priority. Enshassi et al. analysed factors influencing post disaster reconstruction project management for housing provision in Gaza, identifying governance issues as the primary constraint. The research found that weak institutional capacity, unclear regulatory frameworks, and coordination failures between government agencies created systematic bottlenecks that delayed reconstruction more significantly than any other risk category.

Khaddour (2023) examined multi criteria sustainability risk management for post-war residential reconstruction in Damascus, finding that institutional risks dominated the risk landscape. The study revealed that reconstruction projects faced severe challenges including unclear property rights, overlapping authority claims, regulatory ambiguity, and corruption vulnerabilities that stemmed directly from institutional collapse during warfare.

The post-war institutional environment requires reconstruction of governance frameworks simultaneously with physical infrastructure. Legal systems must be reestablished, regulatory bodies reconstituted, and administrative capacity rebuilt. This institutional reconstruction is inherently complex and time consuming, creating a prolonged period of elevated governance risk.

Coordination challenges multiply during reconstruction as numerous actors' government agencies, international organizations, NGOs, private contractors, and community groups converge on reconstruction activities with varying mandates, capabilities, and accountability structures. The literature indicates that coordination failures and institutional conflicts become the primary source of project delays and cost overruns during reconstruction, surpassing even financial constraints in their impact.

2.8.6 Infrastructure deficit risks

Infrastructure damage during warfare creates significant operational constraints for construction projects, but infrastructure deficit risks rank as high rather than critical during active conflict. Projects adapt to degraded infrastructure through workarounds including alternative routing, on site material storage, temporary utilities, and reduced scope expectations.

Infrastructure deficit risks escalate to critical priority during reconstruction. Khattab examined post conflict electricity infrastructure in Gaza, demonstrating that infrastructure deficits became the binding constraint on reconstruction pace. The research found that without reliable electricity, water, and transportation infrastructure, reconstruction projects faced systematic delays, cost escalations, and quality compromises.

Affleck and Freeman analysed challenges for engineering design, construction, and maintenance of infrastructure in Afghanistan, identifying infrastructure deficits as a fundamental barrier to reconstruction. The study revealed that infrastructure reconstruction creates circular dependencies rebuilding infrastructure requires functioning infrastructure that can trap reconstruction efforts in low equilibrium states without coordinated, large scale intervention.

The post-war infrastructure challenge extends beyond physical damage to include capacity and standards deficits. Existing infrastructure may have been inadequate even before conflict, and reconstruction presents opportunities for improvement rather than mere restoration. However, pursuing improved standards within resource constrained reconstruction environments creates tension between aspiration and feasibility.

2.8.7 Technical capacity and standards risks

Technical capacity risks during warfare receive moderate priority as projects lower standards expectations and accept reduced quality in exchange for project completion. Emergency conditions justify expedient approaches, and technical standards enforcement weakens as regulatory bodies lose capacity.

Technical capacity risks increase substantially during reconstruction as quality expectations rise and standards enforcement resumes. Affleck et al. documented that Afghanistan reconstruction projects faced significant technical challenges including inadequate design capacity, construction quality deficiencies, and maintenance system weaknesses.

The post-war technical environment reveals capacity gaps created by conflict. Technical professionals emigrate, training systems collapse, and knowledge transfer breaks down. Reconstruction projects require technical expertise that exceeds locally available capacity, creating dependencies on international technical assistance that introduce coordination challenges and sustainability concerns.

Standards implementation becomes contentious during reconstruction. International donors often require compliance with international standards that exceed local capacity and economic feasibility. The literature indicates that standards conflicts create persistent tensions in reconstruction projects, with debates over appropriate standards consuming significant management attention and delaying project approvals.

2.8.8 Social and community risks

Social and community risks receive low priority during warfare as survival concerns overshadow social considerations. Community engagement processes are minimal, social impact assessments are bypassed, and projects proceed with limited stakeholder consultation. Social risks escalate during reconstruction as communities reassert agency and demand participation in reconstruction decisions. Enshassi et al. found that community engagement challenges were a significant factor in Gaza reconstruction, with tensions arising over project priorities, benefit distribution, and decision-making processes.

Seneviratne et al. examined post-conflict housing reconstruction in Sri Lanka from a community perspective, identifying social cohesion challenges, land disputes, and community expectation management as critical risks. The research demonstrated that projects that neglected social dimensions faced community opposition, implementation delays, and sustainability failures.

The post-war social environment is characterized by trauma, displacement, and social fabric disruption. Reconstruction projects operate within communities experiencing grief, loss, and social tension. The literature indicates that projects that fail to address social and psychological dimensions alongside physical reconstruction face elevated risks of community rejection and long-term failure.

2.8.9 Technological risks

Technological risks during wartime include equipment availability challenges, technology supply chain disruptions, and the challenges associated with maintaining and operating advanced construction technologies in conflict environments. Projects often rely on simpler, more robust technologies that can operate with limited support infrastructure. During reconstruction, technological risks diminish as technology supply chains recover and support infrastructure improves. However, technology adoption challenges such as compatibility concerns, maintenance capacity gaps, and technology transfer difficulties persist. The post-war technological environment offers opportunities for technological leapfrogging by adopting advanced technologies that bypass intermediate development stages. However, the literature lacks historical studies demonstrating that technology adoption should align with local capacity and sustainability requirements to avoid dependence on external support.

2.8.10 Environmental risks

Environmental risks during warfare receive limited attention as environmental considerations are deprioritized relative to immediate survival needs. Environmental regulatory enforcement weakens, and projects proceed with minimal environmental assessment.

Environmental risks remain at moderate levels during reconstruction. While environmental awareness increases and regulatory frameworks resume, resource constraints and reconstruction urgency continue to limit environmental priority. The literature indicates that environmental considerations gradually gain prominence as reconstruction progresses and immediate crises subside, but environmental risks remain moderate rather than high priority throughout early reconstruction phases.

2.8.11 Synthesis and implications

The systematic analysis of risk priority shifts reveals fundamental patterns that have profound implications for construction project management in conflictaffected contexts. The most striking finding is the inversion of risk priorities between war-time and post-war phases: risks that dominate during warfare (security, supply chain) decline substantially during reconstruction, while risks that receive little attention during warfare (governance, infrastructure deficit) become critical during reconstruction.

This risk priority transformation reflects the changing nature of challenges as contexts transition from survival to recovery. War-time risks are predominantly exogenous imposed by external conflict dynamics while post-war risks are predominantly endogenous arising from internal capacity gaps and institutional weaknesses. This shift requires fundamental changes in risk management approach, moving from reactive crisis management during warfare to proactive system building during reconstruction.

The persistence of certain risks across both phases particularly financial and operational risks highlights that some challenges are intrinsic to conflict affected construction rather than phase-specific. These sustained risks require continuous management attention and cannot be assumed to resolve automatically as contexts transition between phases.

The literature provides clear evidence that risk management strategies must be phase-specific and context adapted. Frameworks developed for stable environments prove inadequate for conflict contexts, and furthermore, frameworks appropriate for war-time construction require substantial recalibration for post-war reconstruction. Projects that fail to recognize and adapt to shifting risk priorities face systematic challenges and failures.

This risk priority analysis provides an evidence-based foundation for developing phase-appropriate risk management frameworks for conflict affected construction. The findings demonstrate that one size fits all approaches are inadequate; successful project management in conflict contexts requires sophisticated understanding of how risk profiles transform across conflict phases and adaptive strategies that respond to these transformations.

As previously mentioned, construction projects in active war zones face significant political and security risks, including regime changes, sanctions, and direct armed threats. These conditions endanger both personnel and physical assets and often necessitate protective measures. Studies such as Liu (2023) highlighted insurgency-induced disruptions in Afghanistan; Hodiamont (2010) emphasized how military intervention altered construction management during counterinsurgency operations. Other significant factors include supply chain and logistics disruptions. Since armed conflict, operations, or sanctions severely impact transportation networks and access to critical materials, scarcity and volatile pricing will create supply chain and logistics problems during projects. Skrynkovskyy (2022) identified supply bottlenecks under martial law in Ukraine; Ivanova (2024) reported material shortages and increased costs in conflict-induced construction environments. Furthermore, conflict triggers displacement, recruitment, and security concerns, reducing the availability of skilled labor and displacing local communities. Lyubchenko (2023) documented labor instability during emergency restoration in Ukraine; Liu (2023) highlighted labor mobility issues in Afghanistan.

It is worth mentioning again the political and economic risks from different perspectives. Wartime uncertainty leads to inflation, insurance exclusions, and investor withdrawal. Force majeure provisions are often insufficient to address the complexities of active conflict. Hansen (2024) analyzed contract disputes arising from wartime conditions; Kremers (2010) addressed civil-military contract challenges in fragile environments.

Finally, technological resilience becomes critical under unstable communication and digital infrastructures. At the same time, environmental hazards from rubble and hazardous waste complicate construction site operations. Papirnyk (2024) examined the application of innovative construction technologies under “special conditions”; (Lyubchenko, 2023) highlighted environmental hazards in emergency repair. Table 2.1 summarizes the risks identified according to different categories.

Table 2.2 : Risk typology in contruction projects under war conditions.

Category	Risks Identified	Literature
Political & Security	Regime change, sanctions, armed conflict, terrorism, sabotage	(Ahmadzai, 2024; Liu 2023)
Supply Chain	Infrastructure destruction, shortages of cement/fuel/steel, volatile prices	(Ivanova, 2024; Skrynkovskyy, 2022)
Financial & Contractual	Inflation, funding withdrawal, insurance exclusions, force majeure disputes	(Kremers, 2010; Schreiber,2021)
Operational & Workforce	Labour shortages, displacement, curfews, site shutdowns	(Hodiamont, 2010; Lyubchenko, 2023)
Technological	Weak infrastructure, BIM reliance under unstable networks, limited innovation	(Kassem, 2019; Papirnyk, 2024)
Environmental	Hazardous rubble, toxic debris, sustainability tradeoffs	(Lyubchenko, 2023; Khaddour, 2023)

3. RESEARCH PROBLEM, HYPOTHESIS AND METHODOLOGY

The primary focus of traditional construction risk management frameworks is on stable environments, operating under the assumption of predictable political, financial and logistical conditions. However, these frameworks become inadequate under circumstances of contingent nature, such as armed conflict, geopolitical crises, economic sanctions and technological embargoes. The extant literature on wartime construction has predominantly focused on post-conflict reconstruction or projects within active combat zones. A significant gap in understanding exists regarding the adaptation and management of risks by large-scale, ongoing projects located outside direct conflict zones but subjected to systemic, sanctions-driven disruptions. The present study seeks to address the following research question: How do construction projects identify, assess, and mitigate multidimensional risks under contingent circumstances characterised by economic warfare, supply chain fragmentation, and technological isolation, as exemplified by the Russia-Ukraine conflict.

The main hypothesis of the current study is that, Adaptive frameworks that are focused on resilience and go beyond conventional probabilistic models must be implemented in order to manage risk under uncertain circumstances. A project's success depends not just on identifying context-specific risk typologies but also on the contractor's organizational ability to quickly adapt. Strong finances, varied international sourcing, technology redundancy, and proactive workforce stabilization should all be part of this capability. This study employs a mixed-methods research design that integrates a systematic literature review with an in-depth, longitudinal case study. The methodology is structured in three sequential, interdependent phases to ensure a comprehensive investigation of risk identification, assessment, and mitigation in construction projects under contingent circumstances. The overarching goal is to develop a contextually grounded understanding of risk dynamics and to evaluate the efficacy of adaptive managerial responses. The workflow is visualized in Figure 3.1.

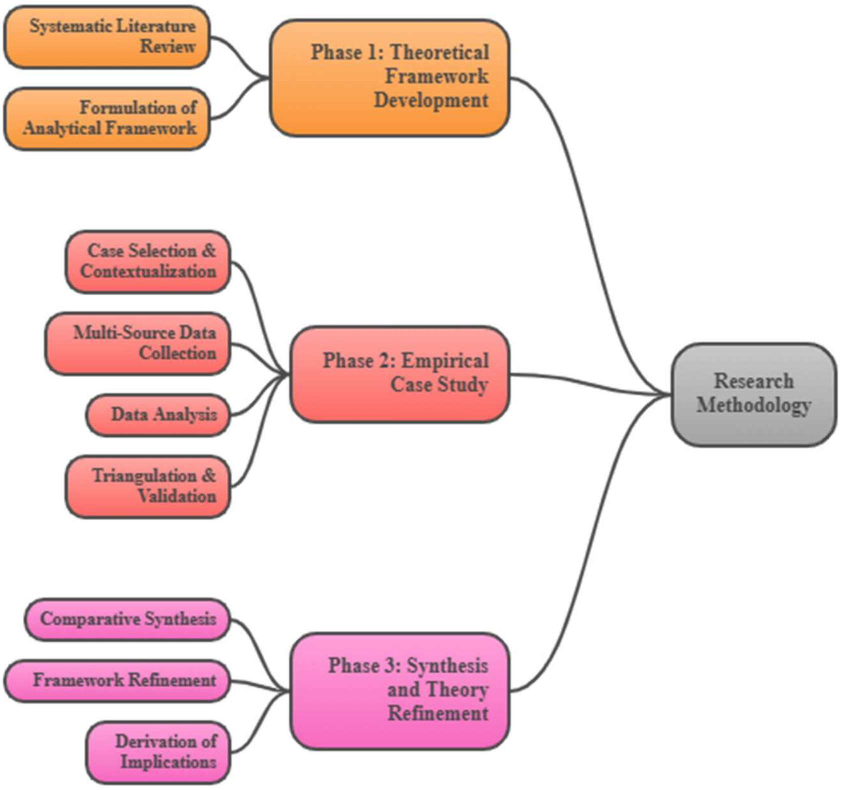

Figure 3.1 : Research methodology and analytical workflow.

The first phase of the study involved establishing the theoretical framework that would form the basis of subsequent research. A systematic review of scientific literature, industry analyses, and policy documents published between 1995 and 2024 was conducted. A comprehensive search strategy was employed to identify relevant sources; with particular emphasis on academic databases such as Scopus and Web of Science, as well as specialized databases focusing on construction management, disaster studies, and geopolitical risk issues. An iterative thematic analysis process was used to extract the identified risks, which were then inductively coded. This process resulted in the synthesis of a multidimensional risk typology that classifies risks into six interconnected areas: (1) Political and Security; (2) Supply Chain and Logistics; (3) Financial and Contractual; (4) Operational and Labor; (5) Technological; and (6) Environmental. This typology served as the primary analytical framework for the subsequent case studies. The Moscow Headquarters Project was selected as a critical case due to its distinctive contextual and operational characteristics. As a large-scale EPC project executed during the Russia-Ukraine war while remaining outside the active kinetic conflict zone, the project represents a prototypical example of developments primarily affected by systemic, sanctions-induced disruptions rather than direct physical damage. Moreover, its prolonged execution under these adverse conditions provides a valuable basis for examining non-kinetic wartime risks and their cumulative impacts on project delivery in depth.

Data Collection & Sources: A longitudinal, multi-source data collection strategy was employed to ensure depth and validity.

Primary Documents: The core data comprised internal project documentation, including the EPC contract and amendments, monthly progress reports, claim and variation order dossiers, procurement and vendor lists, logistics reports, design change logs, and Non-Conformance Reports (NCR).

Financial Data: An analysis was conducted of the Central Bank of Russia exchange rate records (RUB/USD, RUB/EUR) from 2021-2025. These records were analysed in conjunction with project cost reports and payment applications, with a view to tracing financial volatility.

Operational Data: Quantitative measures of disruption were provided by the workforce mobilisation charts (planned versus actual), site management reports and schedule updates (baseline versus actual).

Supplementary Sources: Informal, unstructured consultations with project management personnel provided contextual clarification and anecdotal evidence to supplement documentary analysis.

Data Analysis: The collected data underwent a structured, multi-stage analysis process, the key components of which are explained in the following paragraphs.

Thematic Mapping: Empirical evidence of disruptions and responses was systematically mapped onto the six risk domains of the preliminary typology.

Comparative Analysis: A structured comparison was made between the risks emphasised in the literature (e.g., from Afghanistan, Syria) and those observed in the Moscow project case, identifying convergences and critical divergences.

Process Tracing: In the context of key disruption events (e.g., software sanctions, currency crash), causal sequences were reconstructed in order to understand how the risk materialised and to trace the chain of managerial decisions in response.

Performance Evaluation: The effectiveness of implemented mitigation strategies (e.g. supplier diversification, internal software development) was evaluated based on outcomes related to schedule adherence, cost control, and quality preservation.

The validity and reliability of the text are as follows: The rigour of the methodology was ensured through data triangulation, cross-checking facts across contract clauses, financial records, and progress reports. The utilisation of primary, contemporaneous project documents serves to enhance the construct validity of the case analysis. The meticulous delineation of the case context and the analytical procedures employed lend support to the study's reliability.

The final phase entailed synthesising insights from the extant literature and the empirical case. The comparative analysis resulted in a refinement of the initial risk typology, with the introduction of nuanced sub-categories such as "sanction-induced substitution risk" and "digital infrastructure risk." The integrated findings were used to evaluate the study's central hypothesis and to derive context-sensitive implications for both risk theory and construction management practice under contingent circumstances. This methodology facilitates a robust exploration of the research problem, moving from theory-building through systematic review to theory-testing and refinement via an in-depth examination of a revelatory case.

4. CASE STUDY: MOSCOW HEADQUARTERS PROJECT - BUILDING THE CAMPUS FOR A LEADING RUSSIAN TECH FIRM

In December 2021, a major Russian technology company (hereafter “the Client”) commissioned the design and construction of a new flagship headquarters campus in Moscow. The project was conceived not only as a means of consolidating dispersed corporate functions and personnel, but also as an architectural expression of institutional identity and a long-term platform for innovation, research, and collaboration. The contract for Engineering, Procurement, and Construction (EPC) was awarded to a large, internationally active contractor (hereafter “the Contractor”), a firm with decades of experience operating in the Russian market and a global portfolio spanning multiple continents. The Contractor provides full EPC services and inhouse fabrication capabilities and is consistently listed among the world’s leading international construction firms.

This case study forms part of a broader master’s thesis investigating the effects of wartime conditions on ongoing largescale construction projects. Drawing upon scholarly research, industry reports, and insurance analyses addressing war related construction risks such as sanctions, supply chain disruption, labour constraints, and financial uncertainty the study integrates theoretical and empirical perspectives to examine how these risks materialized and were managed in practice. The central objective is to compare the risk typologies and mitigation strategies identified in the literature with the realities observed onsite: which risks were effectively controlled, which remained unresolved, and what tradeoffs emerged in terms of cost, schedule, and quality outcomes.

Within this analytical framework, the Moscow headquarters project provides an empirical lens through which the multi dimensional impacts of the Russia-Ukraine conflict can be examined at the project level. The outbreak of hostilities in February 2022 introduced systemic volatility into nearly every aspect of the project environment, transforming previously stable operational parameters into dynamic sources of risk. The analysis identifies several interrelated domains of disruption including financial volatility, supply chain fragmentation, technological restrictions, labour instability, and regulatory uncertainty each exerting direct and indirect effects on project performance. By tracing how these disruptions evolved and how the project team responded through adaptive management measures, the study seeks to elucidate the mechanisms through which armed conflict reshapes conventional construction risk structures. The following subsections present these key domains of impact in detail, together with the corresponding mitigation strategies developed to sustain continuity and performance under wartime conditions. Project Scope Key Figures can be seen below:

- The contract was signed on 13 December 2021 between the Client and the Contractor.
- The building comprises up to 15 aboveground floors and 5 basement levels.
- The total construction area is ~ 262,000 m² (above + below ground) including terraces, parking, and shared amenities.
- Office space is estimated at ~ 110,000 m², while parking accommodates ~ 1,630 vehicles (including a multicar parking system).
- The building's envelope features a lightweight façade, clad in metal/titanium panels, aiming both for aesthetic statement and constructability.
- There are multiple wings connected with bridges and open staircases, centered around a luminous "Hub" space, with shared amenities (cafés, museum, indoor green zones) intended to break down silos and stimulate crossteam interaction.
- The Contractor is also responsible for structural steel fabrication: a subcontracting steel firm produced ~ 13,300 tons of structural steel for the project.
- Construction was projected to finish (handover) by mid-2024.

4.1. Project-Level Impacts and Risk Responses Under Conflict Conditions

In the context of wartime construction, "risk" extends beyond the probabilistic interpretation traditionally applied in project management literature. Rather than discrete and measurable events, risks under armed conflict represent dynamic, interconnected processes that evolve in parallel with political and security developments. They manifest not only as threats to cost, schedule, and quality, but as systemic disruptions affecting governance, supply chains, and institutional trust.

Consequently, risk in such environments must be understood as a function of both external volatility and internal organizational resilience. It encompasses tangible dimensions such as material scarcity, labour displacement, and physical damage as well as intangible aspects including uncertainty in regulation, financing, and inter stakeholder communication. Building on the typologies established in the preceding section, the following case study applies this conceptual framework to a real project, illustrating how wartime conditions reshape conventional risk structures and necessitate adaptive management responses.

4.1.1 Effects of currency fluctuations on site management

The following section discusses the operational and financial implications of currency volatility observed during the initial phase of the Russia-Ukraine conflict, as part of the case study project conducted under wartime economic conditions.

The onset of the Russia-Ukraine war in early 2022 resulted in pronounced volatility in the Russian ruble and the euro exchange rates. This instability had a direct and measurable impact on construction projects operating within the affected region. In the examined case, the project's contractual structure involved multiple currencies primarily euro (EUR) and Russian ruble (RUB) based on the specific type of work and the origin of materials. Once exchange rate fluctuations intensified after February 2022, this dual currency payment system exposed the project to significant financial risks. Material procurement costs increased markedly, as suppliers adjusted prices to account for the depreciation of the ruble and the uncertainty surrounding import channels. The project site employed approximately 3,000 workers, with wage payments predominantly made in rubles. However, as the ruble sharply depreciated against the U.S. dollar, the real cost of labour, when converted to a stable currency reference, rose considerably. This dynamic placed substantial pressure on the project's cash flow and budget forecasts. During the monthly progress payment evaluations, the impact of exchange rate misalignment became particularly evident. Payments for work items denominated in rubles failed to offset the simultaneous increase in input costs, resulting in financial deficits in several production categories. Similarly, for works contracted in euros, the fixed contractual exchange rate of approximately 75 RUB/USD became increasingly unfavorable as the market rate diverged sharply from the agreed benchmark. Consequently, these contractual rigidities amplified the project's exposure to currency risk. In summary, the exchange rate volatility that accompanied the escalation of the conflict created a highly unstable financial environment for site operations. It disrupted cost predictability, strained liquidity management, and required continuous financial reassessment to maintain operational continuity. This case highlights how macroeconomic shocks, particularly under wartime conditions, can directly translate into operational, contractual, and financial risks in large scale construction projects.

During February 2022, the Russian ruble experienced heightened volatility amid escalating geopolitical tensions preceding the full-scale invasion of Ukraine. As diplomatic negotiations failed and the conflict appeared increasingly inevitable, the currency weakened sharply due to rising uncertainty and capital outflows. Following the invasion on February 24, 2022, the ruble temporarily collapsed, reaching a peak of approximately 130 RUB/USD in early March, as shown in Figure 4.1 its lowest value in history. However, within the same month, the Russian government and the Central Bank of Russia implemented a series of emergency measures, including strict capital controls and aa sharp interest rate hike, which rapidly stabilized the currency. Consequently, the ruble appreciated significantly by the end of March, illustrating the direct influence of state intervention on short term exchange rate dynamics.

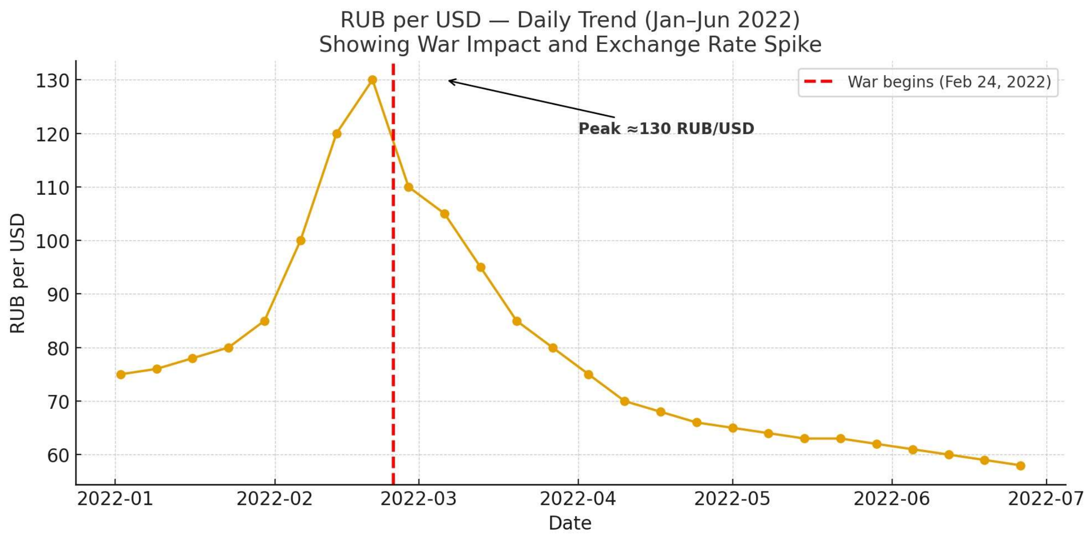

Figure 4.1 : War impact and RUB-USD exchange rate spike first 2 quarter period.

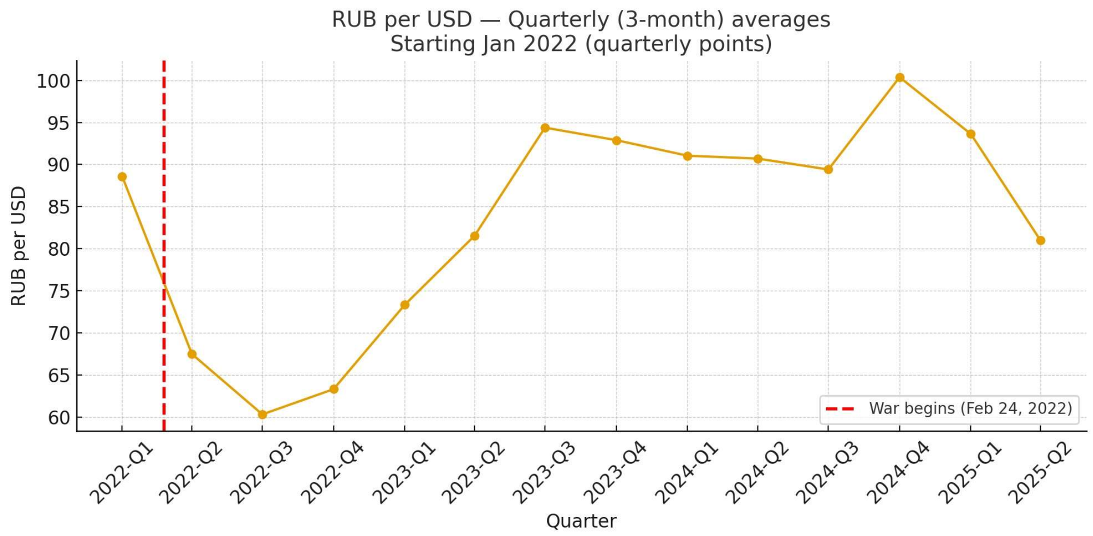

Figure 4.2 : War impact and RUB-USD exchange rate averages quarters from January 2022 to February 2025.

Which is shown in Figure 4.2 the RUB per USD (Russian rubble per US dollar) on a quarterly basis starting from January 2022. The vertical red dashed line marks February 24, 2022, the date when Russia-Ukraine war begin. Immediately after the war began, the ruble sharply depreciated, with the exchange rate rising from around 75 RUB/USD to over 130 RUB/USD in early March 2022 a historical collapse caused by Western sanctions, capital flight, and financial panic. The result of extraordinary state intervention and artificial controls imposed by the Russian government and central bank. The key actions included:

The post invasion appreciation of the Russian rubble was primarily the result of extraordinary state intervention and artificial controls implemented by the Russian government and the Central Bank of Russia. Following the initial sharp depreciation after February 24, 2022, the authorities introduced strict capital controls, restricting foreign currency transfers abroad and compelling exporters to convert up to 80% of their foreign earnings into rubbles. The key interest rate was simultaneously increased from 9.5% to 20% to stabilize the financial system and discourage speculative attacks on the currency. Despite extensive sanctions, Russia continued to export oil and gas, particularly to China and India, and benefited from elevated global energy prices, which preserved a strong current account surplus. At the same time, imports collapsed due to sanctions and the withdrawal of Western firms, reducing foreign currency demand. These combined measures along with direct foreign exchange interventions and strict financial regulations artificially supported the rubbles value. Thus, the currency's recovery reflected policy driven stabilization rather than genuine market confidence or economic strength.

4.1.2 Logistical disruptions and supply chain reconfiguration under wartime conditions

The onset of the Russia-Ukraine conflict in early 2022 triggered severe disruptions across regional logistics networks, significantly affecting the mobility of goods between Europe and the Russian Federation. Traditional transport corridors that previously connected manufacturing hubs in Central and Western Europe to Moscow through Ukrainian territory became inaccessible due to security concerns, airspace closures, and infrastructure damage. Consequently, freight routes were reconfigured through alternative pathways across the Baltic states, Turkey, and the South Caucasus, resulting in extended transit distances, higher freight costs, and prolonged delivery times. In parallel, sanctions and export restrictions on selected equipment and materials imposed by Western governments further constrained procurement options, compelling contractors to identify substitute suppliers in neutral or allied countries. These adjustments transformed logistics management from a routine coordination task into a high risk, time sensitive operation characterized by uncertainty, bureaucratic delays, and escalating costs.

In the case of the Moscow headquarters project, logistical risks manifested through both route reconfiguration and customs bottlenecks. Materials and non-restricted equipment sourced from Europe such as mechanical components, façade systems, and specialized finishing materials could no longer transit via Ukraine, necessitating alternative delivery through longer southern or northern corridors. These detours added substantial transportation time and increased logistical costs by up to several weeks per shipment. Additionally, because many of the new transit countries intensified customs inspections in response to wartime sanctions, clearance procedures became lengthier and less predictable. Even for legally compliant shipments, extensive document verification and origin tracing were required, causing further schedule deviations. As a result, the project experienced delays in material availability, interruptions in procurement planning, and increased inventory holding costs. This case exemplifies how geopolitical disruptions can propagate through logistics systems, converting regional conflict into operational and financial risks at the project level, and demonstrating the strategic importance of adaptive supply chain management in wartime construction contexts.

4.1.3 Material supply sanctions and procurement challenges in wartime construction

The imposition of international sanctions following the escalation of the Russia–Ukraine conflict in 2022 profoundly affected the global construction supply chain. A wide coalition of countries including members of the European Union, the United States, the United Kingdom, Canada, Japan, and South Korea introduced extensive trade restrictions targeting Russian entities and prohibiting the export of dual-use technologies, industrial equipment, and specialized construction materials (European Commission, 2022). These measures encompassed products from leading Western manufacturers such as Siemens, ABB, Honeywell, Schneider Electric, and others whose systems are widely embedded in high performance building projects. As a result, ongoing construction activities in Russia faced an abrupt shortage of approved project materials, especially those governed by international design and certification standards. The sanctions not only constrained procurement options but also imposed regulatory ambiguity: even nonrestricted products were often delayed or denied due to over-compliance by suppliers and logistical intermediaries. This situation created a cascading effect in project delivery, as substitution decisions required technical reassessment, client approval, and design modification each contributing to significant time loss and potential quality compromise.

In the examined Moscow headquarters project, these constraints were particularly evident in the procurement of electromechanical and façade systems. Several critical components such as HVAC control units, electrical switchgear, elevators, and building automation devices were originally specified from Western European suppliers, including Siemens and Schneider Electric. Following the enforcement of sanctions, these firms suspended deliveries and service support to Russia, rendering the approved technical specifications unviable. The contractor was therefore compelled to initiate a comprehensive material substitution process, sourcing alternative equipment from non-sanctioning countries such as China and Turkey. However, the integration of these alternatives presented significant engineering and administrative challenges. Compatibility issues with existing system designs required re-engineering of connection interfaces and performance recalculations, while the absence of recognized certifications raised concerns about long-term reliability and warranty compliance. Approval procedures for substitute materials extended project timelines, as each change necessitated coordination with consultants, designers, and client representatives. Consequently, the sanction-driven material shortages not only disrupted procurement efficiency but also reshaped the project’s risk landscape, highlighting the vulnerability of globally integrated supply chains to geopolitical shocks and emphasizing the need for resilient, multi-source procurement frameworks in wartime construction environments.

Table 4.1 : Baseline vendor list.

#	Dicipline	Systems	Manufacturer 1	Manufacturer 2	Manufacturer 3
1	E	Transformers	V1	V2	V3
2	E	Busbars	V3	V4	-
3	E	Electrical installation products	V2	V5	V3
4	E	Monitoring of power consumption	V3	V2	V6
5	E	Security alarm system	V7	V1	V8
6	M	Jet ventilation	V9	V10	V11
7	M	Chillers	V12	V13	V14
8	M	Precision air conditioners	V15	V16	V17
9	M	Fan Coil	V18	V19	V12
10	M	Radiators	V20	V21	V22

The procurement challenges experienced in the project can be more precisely understood when examined in relation to the original vendor matrix Table 4.1, which categorizes the project’s principal electromechanical systems and the corresponding presanction supply strategy. The Table 4.1 illustrates that the project relied on a structured, multi-tiered vendor shortlist for each critical system including transformer units, busbar distribution systems, electrical installation assemblies, power monitoring platforms, security and alarm systems, jet ventilation modules, chillers, precision cooling systems, fan-coil units, and radiator networks. These systems collectively represent the backbone of the building's electrical, mechanical, lifesafety, and indoor climate infrastructure. Prior to the imposition of sanctions, this vendor structure ensured high interoperability, simplified design coordination, and reliable alignment with international certification standards. Each system category in the table shows two or three alternative manufacturers, indicating a pre-war intention to mitigate commercial or technical risk within a predictable global procurement environment. However, the onset of sanctions fundamentally destabilized this structure. The majority of preapproved vendors originated from European supply chains, rendering the entire vendor matrix effectively inoperable once export restrictions and compliance constraints took effect.

The sanctions were enacted, nearly all system groups listed in Table 4.1 faced immediate procurement paralysis. For high voltage distribution systems such as transformers and busbars, export suspensions eliminated access to equipment designed with specific electrical parameters, protection schemes, and enclosure standards. This forced the project team to identify non-sanctioned suppliers whose products required recalculation of short circuit withstand ratings, thermal performance, and cable coordination compatibility. Similarly, electrical installation assemblies and power-monitoring systems depended on modular components originally selected for their compatibility with the building's automation and energy efficiency objectives. Their unavailability necessitated extensive redesign of control interfaces, metering logic, communication protocols, and fire-safety integration technical adjustments that introduced significant engineering overhead. In the domain of security and life safety systems, the withdrawal of originally specified vendors meant that newly sourced components often lacked accreditation under the same international testing regimes. This introduced challenges relating to certification equivalence, documentation completeness, and long-term warranty assurances, each of which required additional clarification from consultants and the Employer.

Mechanical systems were equally affected. For ventilation, jet exhaust equipment, chillers, and precision cooling units, the table indicates a structured supplier hierarchy prior to sanctions. With these suppliers no longer accessible, substitutions involved recalibrating aerodynamic characteristics, adjusting static pressure requirements, verifying refrigerant compatibility, and confirming compliance with design heat loads and acoustical criteria. The need to redesign and revalidate these parameters extended approval timelines and created sequential delays on-site, particularly in areas where mechanical installation was on the project's critical path.

The logistical dimension of the disruption further amplified procurement complexity. Systems listed in Table 4.1 especially those in the ventilation and chiller categories are large volume items with specialized handling requirements. As sourcing shifted to manufacturers in non-sanctioning regions, shipping distances increased significantly, customs protocols became more restrictive, and freight costs surged. These changes altered procurement lead time assumptions by several weeks, undermining preexisting installation sequences and creating misalignment between planned workforce deployment and actual system availability.

From a financial perspective, the systems identified in Table 4.1 experienced cost inflation that exceeded baseline projections. Alternative suppliers operating outside European markets often offered systems at higher unit prices due to elevated global demand, currency volatility, and limited production capacity. Furthermore, the engineering redesign required to integrate substitutes introduced additional consultancy costs, while prolonged procurement cycles intensified the project's exposure to time-related overheads. The vendor matrix Table 4.1 serves as an essential reference point for understanding the systemic nature of procurement disruption under sanctions. It demonstrates how a project's reliance on globally integrated system architectures originally intended to ensure performance and quality can transform into a liability under wartime.

4.1.4 Continuity of construction during wartime conditions

One of the key risks encountered during the conflict period was the potential disruption of ongoing large scale construction projects that were deemed strategically important for the national economy. The outbreak of hostilities, the imposition of sanctions, and the withdrawal of certain foreign suppliers created a climate of operational uncertainty. In the examined case, these conditions threatened the continuity of works, particularly given the project's reliance on imported materials, international design coordination, and foreign subcontractors. During the early months of the conflict, procurement schedules were interrupted, delivery times expanded, and several planned imports were delayed or cancelled.

Despite this, the project managed to maintain overall progress through rapid adaptation and institutional resilience. The contractor implemented a localized procurement strategy, identified alternative suppliers within domestic and friendly markets, and restructured logistics workflows to comply with emerging restrictions. Strong financial capacity, combined with government prioritization of strategic infrastructure, played a crucial role in preventing extended suspension. As a result, the project's continuity under wartime conditions illustrates how financial robustness, adaptive management, and alignment with national priorities can collectively mitigate one of the most severe risks faced by the construction sector during armed conflict.

4.1.5 Workforce stability and labour mobility under wartime conditions

Another significant risk encountered during the project was the instability of the workforce, particularly within the context of wartime uncertainty and changing security conditions. The construction site's labour composition relied heavily on migrant workers from Central Asian countries such as Uzbekistan and Tajikistan, who constituted the majority of the blue-collar workforce. Following the onset of the conflict, heightened security concerns, social tension, and fears of regional escalation generated anxiety among these workers, resulting in short-term absences and a temporary decline in labour availability.

At the same time, the mobilization policies introduced during the conflict created additional challenges for the project's Russian employees. The possibility of conscription among younger male staff members, particularly within technical and engineering roles, introduced further uncertainty into workforce planning and continuity. Moreover, foreign white-collar specialists—particularly those involved in project management, design coordination, and procurement—demonstrated increased hesitation to remain in the country or travel to the site. This collective environment of uncertainty led to a temporary disruption in staffing levels and coordination efficiency during the early stages of the crisis.

In addition to these socio-political challenges, the project faced financial constraints that indirectly amplified labour instability. The sharp depreciation of the ruble and the corresponding increase in import-related costs placed considerable pressure on the project's overall budget. However, during the initial months of the crisis, wage adjustments were not implemented in parallel with currency fluctuations. As a result, real wages—when measured against inflation and exchange rate losses—declined significantly, prompting a portion of the labour force to leave the project in search of more stable or better-compensated employment. This labour attrition generated measurable delays in site productivity and caused progress rates to fall behind the planned schedule.

The delay in restoring the workforce to its original capacity also resulted in additional temporal and financial costs, as certain construction activities could not proceed sequentially as planned. Once wage corrections were introduced and exchange rate parity was partially restored, the contractor was able to attract and retain skilled labour again, gradually stabilizing manpower levels and bringing production closer to the baseline program. This episode demonstrated the direct interconnection between macroeconomic volatility, wage policy, and project performance under crisis conditions. It further emphasized that timely financial responsiveness particularly in relation to labour remuneration can serve as an essential mitigation tool against workforce erosion in large-scale construction projects operating under wartime or sanction-induced economic pressure.

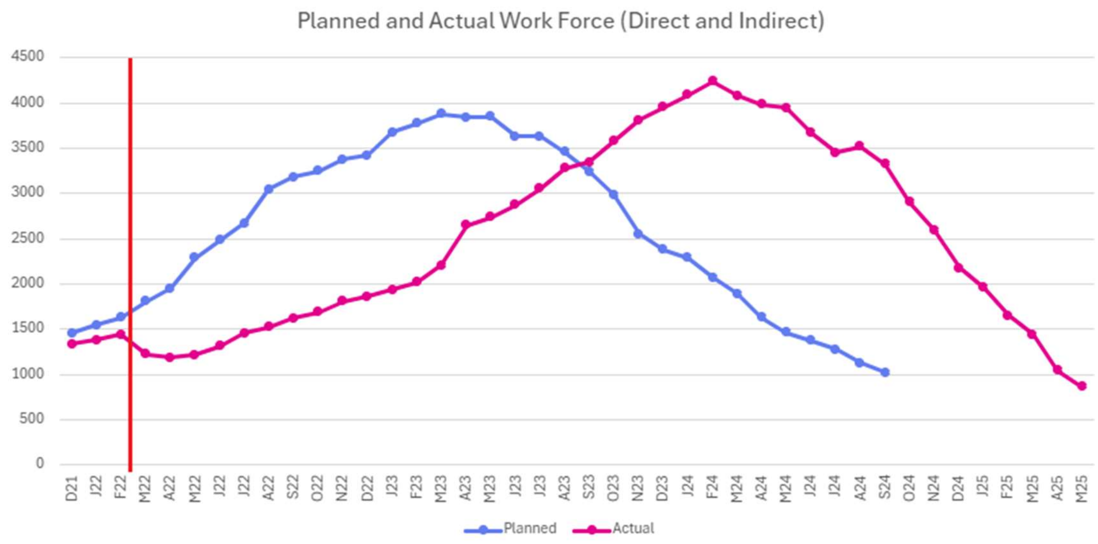

Figure 4.3 : Planned and actual work force.

The workforce instability described in the previous section is further substantiated by the labour trajectory illustrated in Figure 4.3, which presents the planned versus actual workforce levels-incorporating both direct and indirect labour from the main contractor and its subcontractors. The divergence between planned and actual staffing demonstrates the tangible operational consequences of wartime disruptions on labour availability, productivity, and project performance.

The data reveal that labour levels were generally aligned with the baseline program prior to February 2022. However, immediately following the onset of military operations, the project experienced a pronounced decrease in workforce availability. This reduction corresponds directly with the socio-political and security-related uncertainty described earlier, particularly the short-term withdrawal of Central Asian migrant labour, heightened concerns among Russian employees about mobilization policies, and the departure or inactivity of foreign specialists essential for coordination and technical oversight. While the planned workforce continued its upward trajectory reflecting the project's expected ramp-up phase the actual workforce failed to follow this projection. Instead, the contractor sustained a prolonged labour deficit. This misalignment significantly impaired the contractor's ability to execute activities at the intended pace, thereby generating measurable negative schedule variance. The inability to mobilize labour to match the planned resource curve represents one of the primary reasons the project could not be completed within the originally targeted timeline, demonstrating the critical interdependence between labour stability and schedule adherence under crisis conditions.

In addition to the quantitative workforce decline, the project experienced a qualitative degradation of labour capacity. The early-stage loss of skilled personnel, followed by the onboarding of less experienced replacements, further diminished productivity levels. This phenomenon aligns with findings in the wartime labour mobility literature, which emphasizes the productivity penalties associated with the involuntary substitution of skilled workers with lower-skilled labour during conflict-driven workforce reshuffling. The drop in workforce quality compounded the schedule delays and increased operational costs, as inefficiencies in workmanship, reduced task proficiency, and extended learning curves negatively impacted production rates.

Furthermore, the discrepancy between planned and actual labour levels also created a financial burden on the contractor. As the chart indicates, during periods when the planned workforce was expected to peak, the actual workforce remained substantially lower. This mismatch resulted in time-related overhead losses, as the contractor continued to incur fixed project costs over an extended duration without achieving the corresponding planned productivity outputs. Consequently, even though the workforce volume was lower than anticipated, the inefficiency and extended timeline rendered these months financially adverse, contributing to operational losses.

Ultimately, the workforce trajectory depicted in Figure 4.3 reinforces the conclusion that wartime labour disruption constitutes a systemic project risk with both operational and financial consequences. The combination of reduced workforce availability, delayed wage adjustments, loss of skilled labour, and the inability to mobilize resources in accordance with the baseline plan illustrates the multifaceted nature of labour instability under conflict conditions. These outcomes highlight the need for enhanced contingency planning, diversified labour sourcing strategies, rapid wage-adjustment mechanisms, and proactive workforce risk modelling to increase contractor resilience in future projects exposed to geopolitical or macroeconomic shocks.

4.1.6 Technological restrictions and the disruption of digital construction systems

Following the escalation of the Russia–Ukraine conflict in early 2022, international technology sanctions extended beyond financial and trade sectors to include digital infrastructure and software access. Major Western software providers such as Autodesk, Bentley Systems, and Trimble announced the suspension of operations and licensing services in the Russian Federation. These restrictions effectively prevented Russian-based users from accessing or updating critical engineering and design platforms widely used in the construction industry. As a result, ongoing projects faced an unprecedented technological discontinuity: digital workflows dependent on proprietary platforms were disrupted, collaborative data environments became inaccessible, and technical coordination between design and field operations was significantly impaired. This event underscores the emerging category of technological sanctions as a distinct form of wartime risk, capable of undermining both design efficiency and construction management continuity.

Within the examined case project, the technological embargo had a direct and measurable impact on daily construction management activities. The project relied heavily on Autodesk software specifically AutoCAD for 2D and 3D detailing, Revit for Building Information Modelling (BIM), and Naviswork for coordination, progress tracking, and site inspection workflows. These platforms formed the backbone of the project's digital ecosystem, supporting functions such as design review, fabrication drawing approval, and the Non-Conformance Report (NCR) system used for field inspection and quality assurance. Once Autodesk disabled access and licensing renewals for users within the Russian Federation, the project team experienced immediate operational constraints. File sharing, model synchronization, and issue tracking were interrupted, leading to delays in documentation flow and cross-team communication. In response, the contractor initiated a rapid migration to alternative software solutions, including domestically supported CAD platforms and open-source BIM tools. However, these substitutes lacked full compatibility with existing project data and required extensive reconfiguration and staff retraining. Consequently, the technological restrictions not only introduced delays and inefficiencies but also exposed the project's structural dependency on foreign digital systems—illustrating a critical dimension of vulnerability within wartime construction environments.

4.2. Comparative Analysis: Literature vs. Case Study Findings

A comparison between the risks identified in the academic literature on wartime construction and those observed in the Moscow Headquarters Project reveals both significant alignments and notable deviations. While the overarching typologies political and security, supply chain, financial and contractual, operational and workforce, technological, and environmental remain broadly consistent, the Russian case exhibits distinct patterns arising from its unique geopolitical positioning, sanction environment, and institutional resilience. These differences highlight the contextual specificity of wartime risk manifestation and underscore the need to interpret "war-related" risks not as universally applicable categories, but as context-dependent phenomena shaped by each conflict's political economy and regulatory landscape.

4.2.1 Convergences with the literature

The empirical findings from the Moscow Headquarters Project corroborate several risk categories widely discussed in the literature on wartime construction, including studies conducted in Afghanistan, Iraq, Syria, and Ukraine.

First, supply chain disruptions emerged as a dominant and immediate challenge. Consistent with (Ivanova, 2024; Skrynkovskyy 2022) the reconfiguration of logistics routes, prolonged customs inspections, and material scarcity reflected broader patterns of infrastructural fragmentation observed in conflict-affected contexts. The Moscow case further demonstrates that geopolitical constraints, even in the absence of active combat within the country, can propagate similar operational bottlenecks. The currency volatility and inflationary pressures as highlighted by Hansen (2024) manifested acutely through the ruble's sharp depreciation and subsequent state-driven stabilization measures. These macroeconomic fluctuations directly impacted contractual execution, cash flow management, and labour remuneration, confirming the literature's emphasis on financial instability as a central wartime risk. Workforce instability was observed, driven by migration uncertainty, mobilization policies, and wage devaluation. Echoing findings from (Liu, 2023; Lyubchenko, 2023), labour mobility constraints, even in a non-combat zone, materially affected project progress through indirect socio-economic channels. Finally, technological risks notably the sudden suspension of access to digital infrastructure and design software aligned with (Kassem, 2019; Papirnyk, 2024) who stress the vulnerability of technology-dependent project delivery systems under conflict conditions. In this case, the disruption of Autodesk and other Western software licenses introduced a novel form of technological risk, demonstrating how sanctions and digital embargoes can mirror the functional impact of physical infrastructure disruption on project coordination, quality control, and documentation workflows.

4.2.2 Divergences and context-specific features

Despite these alignments, several distinct deviations emerged that differentiate the Russian case from typical wartime construction contexts discussed in the literature.

Most notably, the absence of direct physical conflict within Russian territory meant that the project's risk profile was dominated by economic and geopolitical sanctions rather than by security or infrastructure destruction. In contrast to cases such as Ukraine, Afghanistan, or Syria where physical damage and security risks constrained mobility and safety the Moscow project's disruptions were predominantly systemic: financial, logistical, and regulatory in nature. This divergence indicates that wartime conditions can impose profound project-level risks even without direct exposure to armed violence.

A second major difference concerns institutional and financial resilience. The Moscow project benefited from strong financial capacity, sustained client funding, and government prioritization, allowing continuity despite severe external shocks. This resilience stands in stark contrast to the precarious institutional settings mentioned, when finance withdrawals and governance breakdowns regularly put a stop to construction projects. The ability of the contractor to localize procurement, restructure logistics, and maintain payrolls underscores the buffering role of capital adequacy and state policy in moderating wartime risk intensity.

A third distinctive dimension concerns sanction-induced material and technological substitution. While literature on wartime construction often addresses material shortages due to destruction or import blockades, the Russian case demonstrates a different mechanism: the withdrawal of Western corporate participation due to sanctions and voluntary market exit. The resulting need to replace high-specification components (e.g., Siemens, Schneider Electric) with alternative systems from non-sanctioning countries introduced new layers of engineering, certification, and quality control risk not extensively covered in prior studies. This phenomenon represents a hybrid between supply chain and technological risk categories and suggests an emergent typology "sanction-induced substitution risk" that bridges procurement and design domains.

Finally, while environmental risks were central in post-war reconstruction literature, such concerns were largely absent in the Moscow case (Khaddour, 2023). This absence underscores that environmental hazards are context dependent, typically materializing in post-conflict reconstruction zones rather than in economies under sanctions but not active bombardment.

4.2.3 Implications for risk theory and management practice

The comparative findings suggest that wartime risk frameworks must evolve to incorporate the non-kinetic dimensions of conflict not only the direct physical consequences of warfare, but also the systemic ripple effects of economic sanctions, digital embargoes, and financial countermeasures. Traditional typologies capture the external threats of war, yet understate how policy driven restrictions and market reorientation reshape internal project dynamics. The Moscow headquarters case illustrates that, in modern conflicts, risks can emerge through regulatory isolation and technological decoupling as much as through material destruction.

Moreover, The Project's adaptive strategies localized sourcing, digital migration, and financial stabilization demonstrate a form of organizational resilience absent from much of the conflict-zone literature, which often portrays projects as passive victims of instability. This case therefore expands the conceptual understanding of "construction under conflict" to include scenarios of economic warfare, revealing how global interdependencies transform the boundaries of wartime risk.

4.3. Construction Risks Identified in The Literature Are Compared With The Case Study Findings

The project's experience expands the theoretical model of wartime construction risk to encompass conditions of economic warfare and digital isolation, where sanctions, financial controls, and technology embargoes replace traditional security threats as primary risk drivers. As shown in Table 4.2, five of the six risk categories documented in the literature were present in the Moscow Headquarters Project but expressed through indirect, systemic channels rather than direct war damage.

Table 4.2 : Summary of comparative construction risks.

Risk Category	Typical Conditions in Contingent-Circumstance Construction	Observed Conditions in Case Study
1. Political & Security Risks	Regime instability, armed conflict, security threats, infrastructure damage.	No direct physical threats; risks emerged through sanctions and policy restrictions.
2. Supply Chain & Logistics Risks	Damaged transport routes, mobility restrictions, material shortages, rising costs.	Loss of European transit routes; detours via Turkey/Caucasus; customs delays.
3. Financial & Contractual Risks	Inflation, funding withdrawal, insurance limits, disputes over delays and cost.	Severe currency volatility; contract rigidity in RUB/EUR rates; rising import costs.
4. Operational & Workforce Risks	Labour displacement, safety concerns, curfews, site shutdowns.	Loss of migrant labour; risk of mobilization for Russian staff; reduced productivity.
5. Technological Risks	Disrupted communication, limited digital tools, reliance on vulnerable IT systems.	Loss of access to Autodesk ecosystem; impaired BIM coordination and documentation.
6. Environmental Risks	Debris, pollution, hazardous conditions, sustainability constraints post-conflict.	No environmental hazards; site not affected b

This suggests that contemporary "wartime" construction risks can no longer be understood solely in terms of physical insecurity, but must also include macrofinancial, regulatory, and technological disconnections arising from globalized conflict dynamics.

4.4. Field-Level Adaptations and Managerial Responses

Following the onset of the Russia–Ukraine conflict and the subsequent disruptions analysed in the preceding section, the Moscow Headquarters project entered a critical phase of operational adaptation. While the initial months of the war introduced substantial uncertainty across financial, logistical, and technological domains, the project's continuity ultimately depended on the Contractor's capacity to develop rapid, context-specific mitigation strategies. The following subsections detail the principal field-level interventions implemented between mid-2022 and early-2024, illustrating how a combination of technological substitution, strategic alignment, financial control, and workforce reorganization enabled the project to sustain progress despite unprecedented constraints. These adaptive measures demonstrate the practical translation of risk management theory into organizational resilience at the site level. An overview of these field-level adaptation strategies and their interrelationships is presented in Figure 4.4.

Figure 4.4 : Construction risks sanctions-driven disruptions six core categories.

4.4.1 Technological sanctions and software substitution strategies

The imposition of international technology sanctions in early 2022 resulted in the suspension of licenses for several widely used Autodesk platforms-including AutoCAD, Revit, BIM 360, and Navisworks-within the Russian Federation. This immediately disrupted the digital infrastructure underpinning the project's design coordination, documentation control, and inspection systems, all of which had relied on Autodesk software.

In response, the Contractor initiated an accelerated transition to alternative solutions. A locally developed CAD application replaced AutoCAD as the primary drafting tool, enabling design teams to resume documentation workflows within a sanction-compliant environment. Simultaneously, all cloud storage and file-sharing operations were migrated to Yandex Cloud, a Russian-developed platform capable of sustaining large-scale collabourative data management.

To compensate for the loss of integrated inspection and non-conformance reporting tools previously hosted on BIM 360, the Contractor's IT division developed a proprietary document management and workflow system. This internally engineered software supported field inspection, NCR tracking, and quality documentation processes, thereby maintaining the project's operational continuity. The transition required extensive staff retraining and data migration, causing short-term productivity losses; however, the adaptation ultimately secured compliance with sanction constraints while preserving essential digital and coordination capabilities.

4.4.2 Strategic continuity and political endorsement under wartime conditions

As the Russia-Ukraine conflict escalated, strategic infrastructure and technology projects within the Russian Federation gained heightened political and institutional significance. The Moscow Headquarters project commissioned by a leading national technology corporation was classified as a priority investment due to its symbolic and functional role in supporting domestic innovation capacity.

Despite initial uncertainty in the financial and geopolitical environment, both the Client and federal authorities reaffirmed their commitment to maintaining uninterrupted project execution. The Client continued to meet its financial obligations under the EPC contract, ensuring stable payment flows and resource availability. This alignment between state and corporate priorities reflected a deliberate policy to sustain major capital projects as instruments of economic resilience and political continuity.

For the Contractor, this institutional backing translated into a directive to maintain project momentum under accelerated timelines. The execution strategy was reoriented toward schedule adherence, resource optimization, and visible progress milestones, positioning the project as a demonstration of resilience and stability amid wartime uncertainty.

4.4.3 Financial volatility and exchange rate management

Currency volatility represented one of the most immediate and disruptive consequences of the conflict. Following the invasion in February 2022, the Russian ruble experienced an unprecedented collapse depreciating to approximately 130 RUB/USD in early March followed by a rapid rebound to below 70 RUB/USD within weeks. This extreme fluctuation destabilized contractual and cost-control mechanisms, particularly those involving payments denominated in both rubles and euros.

Local suppliers frequently revised prices in response to market uncertainty, undermining budget forecasts and eroding cost predictability. At the same time, ruble-denominated wages lost purchasing power when benchmarked against foreign currencies, creating additional financial strain for the Contractor's multinational accounting and reporting systems.

As monetary policy interventions by the Central Bank of Russia gradually stabilized the currency, the Contractor adopted a revised financial strategy emphasizing ruble-based transactions, shorter payment intervals, and real-time cost tracking. These measures reestablished a level of fiscal control and mitigated exposure to ongoing currency volatility, allowing more accurate forecasting and improved budget management in later project stages.

4.4.4 Logistical constraints and supply route reconfiguration

The closure of major European transport corridors-particularly those passing through Ukraine had a profound effect on project logistics. Airspace restrictions, sanctions on carriers, and overland transit limitations severed traditional supply chains connecting Moscow to European suppliers. As a result, alternative logistics routes were established through Turkey, Kazakhstan, and the Caspian corridor.

These alternative pathways extended transit durations by a factor of five to six compared to pre-war conditions and significantly increased freight costs. To mitigate the resulting schedule risks, the Contractor implemented an advanced procurement framework based on early ordering, inventory buffering, and multi-route planning. Materials and equipment were ordered months in advance to account for customs bottlenecks and extended clearance times.

Despite these measures, shipments often faced delays of up to six weeks due to inspection procedures and supplier-side administrative inefficiencies. The Contractor's global logistics offices played a crucial role in coordinating multi-jurisdictional customs compliance and securing faster turnaround times where possible. This adaptive logistical strategy exemplified the project's ability to sustain progress through proactive supply chain reconfiguration amid unprecedented geopolitical constraints.

4.4.5 Material procurement challenges under international sanctions

The introduction of comprehensive export sanctions by the European Union, the United States, the United Kingdom, Canada, Japan, and South Korea severely restricted the importation of building systems, mechanical equipment, and specialized materials to the Russian Federation. Many of these sanctioned products were specified in the project's approved vendor list, which included European and American manufacturers such as Siemens.

The unavailability of these pre-approved products necessitated rapid re-engineering of the project's procurement strategy. The Contractor, in coordination with the Client and design consultants, identified alternative suppliers in Turkey, China, and Kazakhstan capable of producing equivalent materials within similar technical and quality parameters.

One notable example involved the façade system: titanium-coated panels originally sourced from a U.S. supplier were redesigned and reproduced by a Chinese manufacturer following rigorous sample testing and performance validation. While these substitutions introduced schedule delays due to testing and re-approval processes, they ultimately maintained project quality standards and contractual compliance. The Contractor's international network of offices facilitated rapid market research, comparative analysis, and supply negotiation, demonstrating the advantages of a globally integrated procurement framework under crisis conditions.

4.4.6 Workforce tabilization and cost optimization

Labour dynamics during the early conflict period reflected both social uncertainty and macroeconomic turbulence. The project's labour force, composed primarily of migrant workers from Central Asian countries such as Uzbekistan, Tajikistan, and Kyrgyzstan, in additionally from İndia initially experienced disruptions due to travel concerns, currency depreciation, and uncertainty regarding Russia's internal stability.

Governmental assurances and policy interventions, however, helped restore workforce confidence and normalize site operations. The Contractor simultaneously addressed labour cost volatility caused by fluctuating exchange rates and rising domestic prices. To balance labour expenses and productivity, the company expanded its international recruitment strategy, mobilizing skilled workers from India through its regional office network.

While the integration of new labour groups required additional time for training and adaptation, the initiative proved financially advantageous, reducing overall labour costs while sustaining production capacity. This approach underscored the Contractor's capacity to leverage its multinational presence to mitigate localized economic pressures and maintain workforce stability under conflict-affected conditions.

4.5. Integrated Assessment of Contractor Performance Under Wartime Conditions

This section provides a consolidated analytical framework situating the contractor's strengths, weaknesses, and operational decision-making within the broader literature on construction management under conflict, sanctions, and systemic disruption. By synthesizing empirical findings from the Moscow Headquarters case study with established research on wartime logistics (Ivanova, 2024), financial volatility, labour mobility, and technological decoupling (Oriekhova, 2024), the analysis illuminates how contractors may function effectively or ineffectively when confronted with geopolitical shocks that transform routine project environments into high-risk operational systems. The four subsections that follow critically evaluate the contractor's performance across interrelated domains, identifying structural vulnerabilities, adaptive capabilities, and the strategic implications of both. This integrative assessment not only clarifies why certain decisions succeeded while others exacerbated risk but also offers insights into how future contractors can enhance resilience through diversified procurement, digital redundancy, proactive financial management, and labour stabilization strategies. This section combines case-based observations with current academic discourse to contribute to a deeper theoretical understanding of contractor behavior under wartime conditions and offers practical lessons for managing large-scale construction projects under external economic and technological constraints.

4.5.1 Contractor's weaknesses

The contractor's performance revealed several structural vulnerabilities that became more pronounced under wartime and sanction-driven constraints. First, the organization exhibited a high degree of technological path dependence (as similarly discussed in conflict-related infrastructure disruptions (Papirnyk, 2024), relying extensively on Autodesk ecosystems for design coordination, BIM integration, and quality management. This overreliance created a single point of failure when international software sanctions were imposed, disrupting critical digital workflows and forcing an unplanned migration to alternative systems. Second, the contractor demonstrated limited preparedness for large-scale geopolitical shocks in its procurement strategy. The initial vendor lists and technical specifications were heavily concentrated on Western suppliers such as Siemens and Schneider Electric, leaving the organization exposed to sudden supply discontinuities and certification incompatibilities. Third, supply chain risk assessments, consistent with gaps highlighted in wartime logistics literature (Skrynkovskyy, 2022) and early-warning mechanisms were insufficiently developed, resulting in delayed recognition of emerging logistical bottlenecks across newly configured transport routes. Finally, the contractor's workforce management strategy proved vulnerable to macroeconomic volatility, as delays in wage adjustments eroded labour stability, an issue also emphasized in conflict-zone labour mobility literature (Liu, 2023) during the early conflict months. These weaknesses illustrate the contractor's underlying exposure to globalized supply chains, foreign technologies, and currency-sensitive labour structures.

4.5.2 Contractor’s strengths

Despite these vulnerabilities, the contractor demonstrated substantial organizational resilience and adaptive capacity throughout the wartime period. A key strength was the firm’s ability to rapidly restructure its procurement architecture by identifying alternative suppliers across Turkey, China, and Kazakhstan, thereby maintaining continuity in the delivery of electromechanical, façade, and finishing systems. The contractor also leveraged its global office network to conduct accelerated technical evaluations, comparative material testing, and compliance documentation, reducing the approval lag typically associated with substitution processes. Additionally, the organization exhibited strong logistical adaptability by reconfiguring transport corridors, implementing multi-route planning, and adopting advanced inventory buffering strategies to mitigate extended transit times and customs-related delays. Financially, the contractor responded effectively to extreme currency volatility, reflecting the macroeconomic instability described in wartime financial studies shifting to ruble-dominated transactions, implementing more frequent payment cycles, and enhancing real-time cost monitoring (Hansen, 2024). Furthermore, the firm successfully stabilized its labour force through targeted wage corrections, expanded international recruitment, and structured workforce retention programs. Finally, rapid development of proprietary digital tools and migration to domestic cloud platforms demonstrated technical ingenuity and reduced long-term dependence on foreign software ecosystems.

4.5.3 Actions the contractor executed effectively

The contractor implemented several effective risk mitigation measures that directly addressed the disruptions observed in the case study. First, the organization prioritized early procurement and front-loaded ordering schedules to counteract the extended transit times caused by reconfigured logistics routes. This anticipatory planning reduced critical-path exposure and safeguarded activity sequencing. Second, the contractor’s decision to engineer alternative façade, electromechanical, and automation systems-supported by rigorous testing and consultant review-allowed the project to maintain technical compliance without sacrificing performance standards. Third, the rapid development of an internal document management and site management platform successfully compensated for the loss of BIM360 functionality, demonstrating strong digital resilience. Fourth, by securing political and institutional backing from the Client and state authorities, the contractor aligned project execution with national strategic priorities, ensuring uninterrupted cash flow and regulatory support. Finally, the contractor's expanded international recruitment and corrective wage strategy effectively restored workforce stability, allowing production rates to recover during the later stages of the conflict.

4.5.4 Actions the contractor executed ineffectively

Several strategic and operational missteps also emerged during the wartime adaptation process. Most notably, the contractor’s initial risk management protocols underestimated the scale and immediacy of sanction-driven disruptions, delaying the mobilization of alternative suppliers and prolonging material shortages. The pre-war procurement strategy’s dependency on Western manufacturers created an avoidable concentration risk that required substantial redesign and administrative re-approval once sanctions were enacted. Furthermore, the organization’s limited investment in digital redundancy and local software compatibility prior to the conflict resulted in significant productivity losses following the suspension of Autodesk services. In workforce management, delayed wage adjustments exacerbated labour attrition and hindered early-stage productivity, revealing insufficient integration of macroeconomic indicators into human resource planning. Finally, contingency planning for geopolitical escalation particularly in relation to logistics routing and customs risks was not sufficiently robust, contributing to schedule deviations during the first months of the conflict.

Overall, these weaknesses underscore the importance of diversifying technical dependencies, strengthening early-warning procurement systems, integrating geopolitical risk forecasting into project management, and maintaining proactive financial responsiveness in volatile environments.

4.6 Claim Formation and Management Under Wartime Conditions

In the Moscow Headquarters Project, claim formation and management unfolded under a legal and operational environment fundamentally different from standardized international frameworks such as FIDIC. Whereas FIDIC provides a formalised, procedure-driven claim mechanism centred on timely notification, engineer determinations, and structured evaluation processes, the Russian system relies primarily on the statutory pre-trial claim procedure (претензионный порядок) embedded in domestic civil and commercial law. Under wartime conditions—characterised by sanctions, supply chain disruption, currency volatility, and technological isolation these systemic differences became more pronounced. Claims arose not through Variation Orders or engineer-issued instructions, but through disputes related to additional works, cost escalations, procurement delays, and contractual rigidity. As such, wartime disruptions did not merely trigger new categories of claims; they reshaped the procedural landscape in which claims were articulated, evaluated, and resolved, illustrating how conflict conditions alter both the substance and governance of contractual entitlements.

Within this wartime context, two primary categories of claims emerged in the Moscow Headquarters Project. The first concerned additional works, functionally analogous to Variation Orders in international contracting practice, though governed under Russian law as "additional works" (дополнительные работы) rather than through a formal FIDIC-style variation mechanism. These claims typically arose from design adjustments, scope expansions, engineering revisions, or the need to re-sequence construction activities in response to disrupted logistics and shifting project priorities. The second category involved sanctions-induced material and equipment substitution, a distinct form of claim originating from the inability to procure previously approved European or American products due to export restrictions. In these cases, the contractor was compelled to source technically equivalent alternatives from non-sanctioning countries, a process that required renewed engineering assessments, technical compliance reviews, and approval procedures. The resulting delays, cost differentials, and design modifications formed the basis for compensation and schedule claims. These two claim types illustrate how wartime disruptions generated both conventional scope-related entitlements and novel, sanction-driven contractual impacts, thereby expanding the traditional typology of construction claims under conflict conditions

4.6.1 International framework for construction claims (FIDIC-based practice) ans Russia Federation framework for (domestic law and courts)

In international construction practice, contractual claims are most commonly structured with reference to standard forms such as the FIDIC Conditions of Contract, which provide a detailed, procedure-driven framework for the contractor's entitlement to additional time and/or payment. Under FIDIC, a "claim" is typically understood as a formally notified request arising from events such as Variations, employer-caused delay, unforeseen conditions, or changes in law, and is governed by strict requirements on notice, substantiation, and engineer determination (particularly Clauses 13 and 20). In this model, the Engineer plays a central, quasi-adjudicative role by assessing the claim, determining the extent of entitlement, and issuing decisions that may later be challenged before a Dispute Adjudication/Avoidance Board or international arbitration.

Table 4.3 : Comparison of FIDIC and Russian Federation local courts.

Aspect	FIDIC framework	Russian legal framework
Definition of Claim	Formal procedure governed by Clause 20 (notice + substantiation required).	Pre-trial claim procedure (Претензионный порядок) submitted before litigation.
Variation	Managed and instructed by the Engineer; formal Variation Orders issued.	Treated as "additional works" (Дополнительные работы); no formal Variation Order mechanism exists.
Role of Engineer	Acts as an impartial decision-maker under Clause 3.5.	No comparable neutral Engineer role; functions limited to technical supervision.
Time Limits	Specific contractual notice periods (e.g., 28 days); time-bar possible.	No strict contractual notice regime; only the pre-trial 30-day response requirement generally applies.
Dispute Resolution	DAB/DAAB Arbitration (international).	Local commercial courts (Арбитражный суд); arbitration only if explicitly agreed.
Procedural Character	Formalised, document-driven, standardised across jurisdictions.	More legalistic, contract-driven, and dependent on statutory interpretation.

By contrast, construction claims in the Russian Federation are generally not administered through FIDIC-style standard forms but are instead governed by domestic law, notably the Civil Code of the Russian Federation (including the chapter on construction contracts) and the Commercial Procedure Code. In this context, claims are typically advanced through a mandatory pre-trial complaint procedure (претензионный порядок), in which the contractor submits a written demand to the employer before any recourse to the state Commercial (Arbitration) Courts (Арбитражный суд). Scope changes and additional works are treated as "additional works" (дополнительные работы) rather than formal Variations instructed by an independent Engineer, and the resolution of disputes depends primarily on contractual wording, statutory provisions, and judicial interpretation rather than on standardised international contract mechanisms. Table 4.3 compares the FIDIC-based international claim framework with the Russian Federation domestic system.

4.6.2 Implications of divergent claim frameworks for the moscow headquarters project

The divergence between the FIDIC-based international claim framework and the domestic Russian model had direct implications for how wartime disruptions were translated into enforceable entitlements in the Moscow Headquarters Project. Under a FIDIC regime, many of the events described in this case sanction-induced material substitutions, currency volatility, logistics-driven delay, and redesign requirements would likely have been channelled through a dense sequence of notices, engineer determinations, and formally quantified claims for extension of time and additional cost. By contrast, the Russian legal environment required the Contractor to articulate its grievances primarily through the pre-trial complaint mechanism, with limited procedural guidance on how wartime events should be documented, priced, and causally linked to employer risk.

This structural difference created both opportunities and constraints for the Contractor. On the one hand, the absence of strict contractual notice periods and formal time-bar provisions reduced the risk that claims would be rejected purely on procedural grounds, as can occur under FIDIC where late notification may extinguish entitlement. On the other hand, the lack of a neutral Engineer and a codified variation mechanism meant that many wartime impacts remained in a grey zone, negotiated informally rather than processed through transparent, standardised claim channels. In practice, this placed a premium on the Contractor's ability to maintain robust contemporaneous records of design changes, procurement delays, cost escalations, and re-sequencing decisions, so that these could later be framed as additional works or compensable losses within the domestic legal framework.

The wartime context further complicated claim formation by blurring the distinction between force majeure, employer risk, and contractor risk. International practice under FIDIC typically differentiates between excusable delay (entitling the contractor to time but not cost) and compensable delay (entitling to both time and money), with reference to detailed risk allocation clauses. In the Moscow Headquarters Project, however, the interaction of sanctions, currency shocks, and technology embargoes produced hybrid scenarios in which causation was shared between external geopolitical factors and project-specific procurement choices (e.g., dependence on sanctioned vendors). This made it more difficult for the Contractor to assert that all consequences of wartime disruption fell within the Employer's risk sphere. As a result, many potential claims were effectively diluted at the interface between legal doctrine and practical negotiation, with only a subset crystallising into formal pre-trial complaints.

From a risk-management perspective, the case illustrates that claim strategy under wartime conditions cannot be divorced from the governing legal framework. In an international FIDIC setting, the Contractor would have needed highly disciplined notice and record-keeping procedures, but could have relied on a more predictable path from disruptive event to adjudicated entitlement via the Engineer and dispute boards. Under the Russian framework, by contrast, the Contractor enjoyed greater procedural flexibility but faced higher uncertainty regarding evidentiary thresholds, judicial interpretation of wartime events, and the extent to which sanctions and macroeconomic instability would be recognised as grounds for compensation.

4.6.3 Case-specific claim examples

In the Moscow Headquarters Project, two representative claim cases illustrate how wartime disruptions and employer-driven design decisions were translated into contractual entitlements for additional time and cost. Both claims were processed through the contractor's internal variation and claim workflow, schematically presented in Figure 4.5, which begins with notification of a design change or variation request and proceeds through design review, site verification, cost and time impact analysis, and finalisation of a formal claim report to the Employer. The sequence demonstrates that claim formation was not an ad hoc reaction to isolated events, but a structured, multi-departmental procedure integrating technical, commercial, and legal assessments.

4.6.3.1 Claim 1: Sanction-induced substitution of previously approved equipment

The first claim concerned the substitution of an item of electromechanical equipment that had been formally approved in the pre-war vendor list but subsequently became unobtainable in the Russian Federation due to international sanctions. Although the system in question remained technically desirable, export restrictions rendered its delivery legally and logistically impossible. In accordance with the workflow depicted in Figure 4.5, the Employer was notified of the procurement impossibility and the contractor's Design Department initiated a technical reassessment to identify functionally equivalent alternatives from non-sanctioning jurisdictions.

This reassessment generated a cascade of additional activities, including redesign of interfaces, recalculation of capacities, revision of shop drawings, and renewed coordination with other building systems. The Procurement Department then obtained updated quotations and lead times for the substitute equipment, while the Site Department evaluated the impact of extended delivery periods on installation sequencing and overall programme milestones. The Cost Control Department consolidated these inputs into a comprehensive cost-impact analysis, distinguishing direct costs (price differential for the substitute equipment, additional engineering hours, supplementary testing and commissioning) and indirect costs (extended site overheads, disruption to established work fronts, and programme prolongation). Supporting evidence comprised vendor correspondence, revised technical submittals, updated delivery schedules, design coordination minutes, and programme comparisons. On this basis, a formal variation claim was prepared and submitted to the Employer, seeking compensation for both the additional procurement expenditure and the time-related overheads arising from sanction-driven substitution.

4.6.3.2 Claim 2: Employer-initiated design changes and late approvals

The second example related to a series of design modifications and late approvals initiated by the Employer. During execution, the Employer requested functional and architectural changes which required revisions to previously approved design documents and shop drawings. At the same time, several key design approvals were significantly delayed, preventing timely release of construction information to the site. These events collectively disrupted planned work sequences, caused idle time for labour and equipment, and necessitated re-work in partially executed areas.

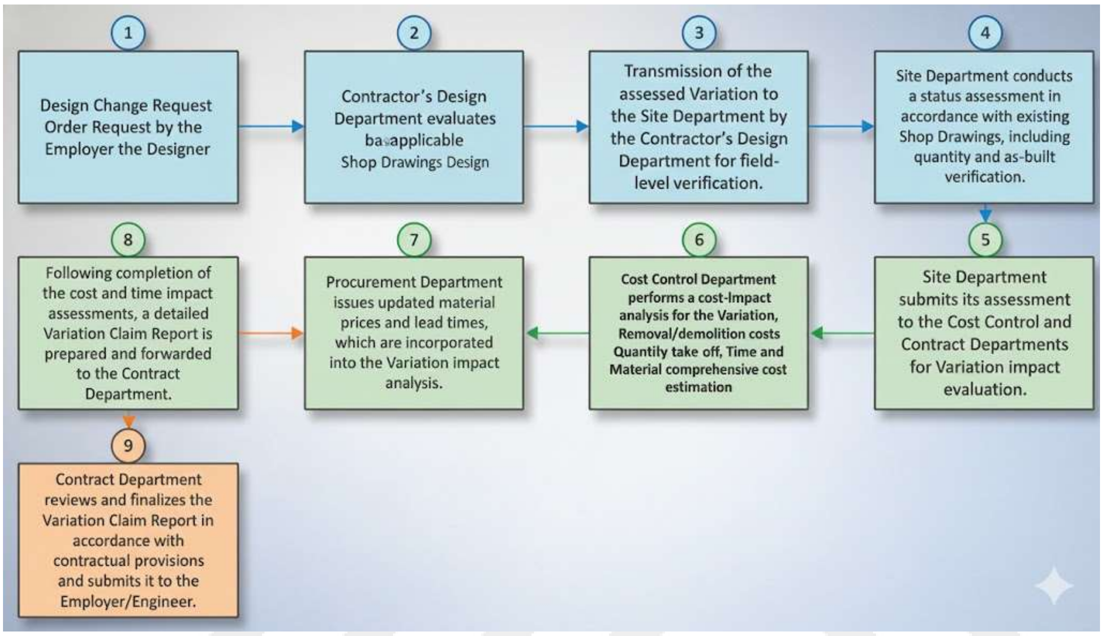

Figure 4.5 : Contractor's project management plan, claim procudure workflow.

Following the internal process outlined in Figure 4.5, each change request and delayed approval was logged and transmitted to the Design and Site Departments for technical and field level assessment. The Site Department documented the status of works at the time of instruction, prepared quantity take-offs for removal and re-installation where necessary and recorded associated disruption and standby periods. Parallel to this, the Planning and Cost Control teams analysed the effect on the critical path, quantifying extension-of-time requirements and calculating the resulting direct costs (demolition, additional materials, re-installation works) and indirect costs (extended preliminaries, inefficiencies from re-sequencing, and loss of productivity). The evidentiary package included dated design instructions, approval logs, site diaries, photographs, updated programmes, and labour and equipment utilisation records. These materials were consolidated into a detailed variation claim dossier submitted to the Employer, requesting both time relief and monetary compensation.

For future projects operating under similar conditions, several lessons emerge. First, contractors working under domestic law systems should negotiate, where possible, contractual clauses that emulate key protective features of international standard forms such as explicit mechanisms for additional works, price adjustment, and time extension in the event of sanctions or regulatory change. Second, claim preparation should be integrated into day-to-day project governance, with systematic tracking of delay drivers, cost variances, and scope modifications from the outset of a crisis, rather than only after disputes materialise. Third, legal and commercial teams must be closely aligned with technical and planning functions so that the complex effects of wartime disruptions can be translated into coherent, evidence-based narratives suitable for pre trial complaint procedures and, if necessary, court proceedings.

Taken together, these observations demonstrate that the Moscow Headquarters Project not only reveals how wartime risks manifest at the level of cost, time, and technology, but also how they are filtered through the institutional architecture of claim resolution. The interaction between sanctions-driven disruption and the domestic Russian claim framework constitutes a critical, and often overlooked, dimension of construction risk under conflict conditions.

5. CONCLUSIONS

Construction projects undertaken under contingent circumstances operate within a fundamentally altered risk environment, one that far exceeds the boundaries of traditional project uncertainties. As demonstrated throughout this study, such circumstances generate multidimensional risks that encompass political and regulatory instability, supply chain disruptions, financial volatility, workforce fragility, technological constraints, and in certain contexts environmental hazards. These risks interact dynamically and systemically, creating operational uncertainties that challenge the assumptions of conventional risk management approaches. Consequently, construction projects exposed to contingent conditions require analytical frameworks and managerial strategies that are highly adaptive, context-specific, and resilience-oriented. The literature consistently emphasizes that project continuity under contingent circumstances depends on financial robustness, institutional support, and the capacity to maintain operational flexibility. The Moscow Headquarters Project substantiates these insights while illustrating how risk manifestation in contemporary geopolitically contingent environments has evolved. Unlike classical crisis-affected contexts characterized by physical damage to infrastructure, this project was shaped primarily by non-kinetic, sanctions-driven, and system-level disruptions including the withdrawal of international vendors, technological embargoes, currency volatility, reconfigured logistics networks, and uncertainties within migrant labour markets. These conditions generated systemic instability requiring rapid managerial adaptation, iterative risk reassessment, and innovative sourcing strategies. Among the most prominent challenges was workforce instability, driven by migrant labour shortages, security-related anxieties, policy-induced mobility constraints, and the erosion of real wages caused by macroeconomic fluctuations. These disruptions resulted in measurable productivity losses and increased operational costs, paralleling findings within the literature on contingent labour environments. Supply chain fragility emerged as another dominant constraint: the loss of established transportation routes, material scarcity, and intensified customs procedures necessitated a strategic pivot toward localised procurement, diversified supplier networks, and modular construction methods approaches increasingly recognised as essential for mitigating exposure to fragile global logistics systems.

This study also confirms that traditional, probability-based risk management methods are insufficient under contingent circumstances, where deep uncertainty, rapidly shifting constraints, and institutional variability undermine the assumptions of standard forecasting models. Effective management in such environments therefore depends on adaptive, multi-method risk frameworks, incorporating qualitative assessments, stakeholder engagement, and flexible contractual provisions, particularly concerning force majeure, cost adjustments, and schedule entitlements. Furthermore, the analysis demonstrates that suspension and restart cycles prevalent under contingent operational landscapes contain latent schedule risks that often exceed the duration of the initial disruption, reinforcing the need for specialised planning, early procurement strategies, and resource buffering. A key contribution of this research lies in its demonstration of how a large international contractor can leverage organisational scale, global procurement networks, financial stability, and in-house engineering capacity to mitigate contingency induced disruptions. The contractor's responses including rapid vendor substitution, re-engineering of sanctioned systems, technological migration, and international workforce mobilisation reflect significant institutional resilience. At the same time, the case reveals structural vulnerabilities arising from technological path dependence, concentrated vendor lists, delayed wage adjustments, and insufficient geopolitical early warning mechanisms. These findings indicate that resilience is not merely a function of organisational size but of strategic foresight, diversification, and adaptive capability.

Overall, this research demonstrates that successful project delivery under contingent circumstances depends on the capacity to anticipate, absorb, and adapt to multidimensional and rapidly evolving risks. This requires recognising that such conditions are not anomalous but increasingly relevant operational realities in a globalised and geopolitically volatile environment. Accordingly, construction risk management frameworks must evolve to include sanctions-driven disruptions, technological embargoes, non-linear supply chain risks, and socio-economic determinants of workforce instability. By synthesising theoretical insights with empirical evidence, this study contributes to a more comprehensive understanding of construction management under contingent circumstances and underscores the need for resilience-oriented, context sensitive guidelines tailored to projects operating within complex geopolitical and economic conditions.

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