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Proactive Risk Management in Healthcare Construction Projects

Master's thesis in the Master's Programme Design and Construction Project Management

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ABSTRACT

Healthcare construction projects are characterised by high complexity, multiple stakeholders, strict operational requirements and the need to maintain ongoing healthcare services during construction activities. These conditions create significant challenges for effective risk management and increase the importance of proactive approaches that support early identification and mitigation of risks.

The aim of this study was to analyse current risk management practices in healthcare construction projects and develop a proactive risk management framework adapted to the specific characteristics of healthcare environments. The study focused on public healthcare construction and renovation projects and addressed four research questions related to current risk management practices, critical risk types, factors affecting risk management effectiveness and conditions for improving proactive risk management.

A qualitative research approach was adopted. The study combined a structured literature review with semi-structured interviews conducted with six professionals involved in healthcare construction projects. The empirical data were analysed using thematic analysis, allowing key patterns and themes to be identified and compared with existing theory and literature.

The findings show that risk management is generally well established during the planning phase through risk workshops, risk registers and structured assessments. However, the results indicate a clear gap between planning and execution. During construction, risk management becomes more reactive, informal and heavily dependent on individual experience. Several critical risk categories were identified, including technical system risks, operational risks, coordination risks, organisational risks and scheduling risks. The findings also demonstrate that risk management effectiveness is influenced by factors such as communication, stakeholder coordination, organisational culture, governance structures and time pressure.

Based on the findings, a proactive risk management framework was developed. The

framework emphasises continuous monitoring, stakeholder collaboration, early risk identification, organisational learning, clear responsibilities, communication and digital support. The study concludes that improving risk management in healthcare construction projects requires not only better tools and processes but also stronger integration between project phases and a more proactive organisational culture.

The study contributes to both research and practice by providing insights into how risk management can be strengthened in complex healthcare construction environments and by proposing a framework that supports proactive decision making throughout the project lifecycle.

Keywords: Risk Management, Healthcare Construction, Proactive Risk Management, Construction Projects, Healthcare Facilities, Organisational Risk Management, Project Management.

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SAMMANFATTNING

Vårdbyggnadsprojekt kännetecknas av hög komplexitet, många intressenter, omfattande tekniska system samt krav på att vårdverksamheten ska kunna fortsätta under byggtiden. Dessa förutsättningar skapar betydande utmaningar för riskhantering och ökar behovet av proaktiva arbetssätt som möjliggör tidig identifiering och hantering av risker.

Syftet med denna studie var att analysera nuvarande riskhanteringspraktiker i vårdbyggnadsprojekt samt utveckla ett ramverk för proaktiv riskhantering anpassat till vårdmiljöers specifika förutsättningar. Studien fokuserade på offentliga vårdbyggnads- och ombyggnadsprojekt och undersökte hur riskhantering genomförs i praktiken, vilka risker som är mest kritiska, vilka faktorer som påverkar riskhanteringens effektivitet samt hur ett mer proaktivt arbetssätt kan utvecklas.

Studien genomfördes med en kvalitativ forskningsansats där en strukturerad litteraturstudie kombinerades med semistrukturerade intervjuer med sex yrkesverksamma personer inom vårdbyggnadsprojekt. Det empiriska materialet analyserades genom tematisk analys och jämfördes med etablerade teorier och tidigare forskning inom riskhantering.

Resultaten visar att riskhanteringen generellt är väl strukturerad under planeringsfasen genom riskworkshops, riskregister och formella riskanalyser. Samtidigt identifierades en tydlig skillnad mellan planering och genomförande. Under produktionsskedet blir riskhanteringen mer reaktiv, mindre strukturerad och i hög grad beroende av individers erfarenhet och kunskap. Studien identifierade flera centrala riskkategorier, bland annat tekniska risker, operativa risker, samordningsrisker, organisatoriska risker samt tids- och planeringsrisker. Resultaten visar även att kommunikation, samverkan mellan aktörer, organisationskultur, styrningsstrukturer och tidspress har stor påverkan på riskhanteringens effektivitet.

Utifrån resultaten utvecklades ett ramverk för proaktiv riskhantering. Ramverket

bygger på kontinuerlig uppföljning, tidig riskidentifiering, samverkan mellan intressenter, organisatoriskt lärande, tydligt ansvarstagande, effektiv kommunikation och användning av digitala verktyg. Studien visar att förbättrad riskhantering kräver både organisatoriska och processrelaterade förändringar för att skapa en mer proaktiv och integrerad hantering av risker genom hela projektets livscykel.

Studien bidrar med ökad förståelse för riskhantering i komplexa vårdbyggnadsprojekt och presenterar ett praktiskt ramverk som kan stödja beslutsfattande och riskhantering i framtida projekt.

Nyckelord: Riskhantering, vårdbyggnadsprojekt, proaktiv riskhantering, byggprojekt, sjukhusprojekt, organisatorisk riskhantering, projektledning.

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Gothenburg, June 2026

Ouies Khalil

Contents

1 Introduction

Risk management has become an increasingly important topic within the construction and property management sector, particularly in projects characterised by high complexity and uncertainty (Taroun & Yang, 2022; Marle & Gidel, 2021). Construction projects are frequently exposed to risks related to cost, schedule, quality, safety, technical systems and coordination among multiple stakeholders (El-Sayegh et al., 2021; Li et al., 2022). These risks become even more significant in healthcare construction projects, where construction activities may directly influence ongoing healthcare operations and patient safety (Love et al., 2021).

Healthcare facilities represent complex environments that must operate continuously while construction, renovation or expansion activities are performed. In such contexts, disruptions caused by construction activities may have consequences that extend beyond traditional project outcomes and influence essential services (Marzouk & Azab, 2020). Therefore, risk management in healthcare construction projects requires not only technical and project related considerations but also organisational coordination and proactive decision-making (Olanrewaju & Babarinde, 2021).

Public sector organisations responsible for healthcare properties face additional challenges due to governance structures, regulatory demands and long term operational responsibilities (Klakegg et al., 2021). These conditions increase the need for structured approaches to risk management that can support decision making across different project phases (Marle & Gidel, 2021). As a result, proactive risk management has become an important area of research and practice within healthcare construction (Taroun & Yang, 2022).

This thesis focuses on risk management practices in healthcare construction projects and aims to explore how proactive approaches can support early identification of risks and improved decision making. By analysing current practices in relation to existing theories and frameworks, the study seeks to contribute to both academic understanding and practical development of risk management strategies within healthcare construction projects.

1.1 Background

Construction projects are widely recognised as complex and uncertain processes involving temporary project organisations, changing conditions and multiple actors. Previous research has shown that construction projects often experience cost overruns, schedule delays and coordination challenges due to insufficient risk management practices (Zou et al., 2007; El-Sayegh et al., 2021). Although several standards and frameworks for risk management exist, their implementation and effectiveness vary significantly between projects and organisations.
Construction projects are frequently described as high uncertainty environments due to their uniqueness, interdependencies and dynamic stakeholder structures (Flyvbjerg, 2014). Empirical studies show that optimism bias and strategic misrepresentation may further increase the likelihood of cost overruns and delays in large infrastructure and public projects (Flyvbjerg, 2014). This highlights the importance of systematic and structured risk management approaches that go beyond informal experience based decision making (Aven, 2016; Hillson, 2017; Li et al., 2022).

International standards such as ISO 31000 emphasise that risk management should be integrated into organisational processes and decision making (ISO, 2018). Project oriented frameworks such as PMBOK further describe how risk management can be applied at the project level through structured processes including risk identification, analysis, response planning and monitoring (PMI, 2021). Despite the availability of these frameworks, many construction projects continue to rely on reactive approaches where risks are addressed after problems emerge rather than being proactively managed (Taroun & Yang, 2022).

Healthcare construction projects introduce additional complexity compared to conventional construction projects. Healthcare facilities depend on critical systems such as electricity, ventilation and medical infrastructure which must remain operational even during construction work. National guidelines and public sector recommendations emphasise the importance of planning and coordination to minimise risks related to disturbances, safety and operational continuity (SKR, 2019; MSB, 2018).

Within public healthcare property management, construction projects must balance operational demands, regulatory requirements and long term strategic objectives. These factors contribute to increased complexity and highlight the need for effective and proactive risk management approaches adapted to healthcare construction environments.

1.2 Problem Formulation

Although risk management is widely recognised as important in construction projects, research indicates that a gap often exists between theoretical frameworks and practical implementation. Risk management activities are frequently documented through risk registers and formal processes but these tools are not always actively used to support decision making or continuous learning throughout the project lifecycle (Gajewska, 2011; El-Sayegh et al., 2021).

Several studies argue that traditional risk registers often fail to function as decision support tools and instead become static documentation artifacts (Kutsch & Hall, 2010; Williams et al., 2012). Furthermore, early warning signals in projects are frequently ignored due to organisational culture, cognitive bias or lack of clear responsibility structures (Serra & Kunc, 2015). Recent research has confirmed that ineffective integration of risk management processes into daily project decision making remains a common challenge in construction projects (Li et al., 2022). These findings indicate that improving risk management requires not only better tools but also organisational change and stronger governance mechanisms (Arena et al., 2010; Marle & Gidel, 2021).

In healthcare construction projects, this gap becomes particularly critical because failures or disruptions may have serious consequences for healthcare operations and safety. Risks related to technical systems, coordination between construction activities, ongoing operations and communication between stakeholders require early identification and proactive management. However, many projects still rely on reactive approaches, focusing on solving problems after they have emerged rather than preventing them (Taroun & Yang, 2022).

Public sector construction projects may face additional challenges related to governance structures, procurement procedures and organisational complexity. These factors can influence how risk management is performed, communicated and integrated

into project processes (Klakegg et al., 2021). As a result, there is a need to better understand how risk management can be improved and adapted to healthcare construction environments.

The central problem addressed in this study is the lack of a structured and proactive risk management approach that effectively supports early risk identification and decision making in healthcare construction projects.

1.3 Aim and Research Questions

The overall aim of this master's thesis is to analyse current risk management practices in healthcare construction projects and to develop a proactive risk management framework adapted to the specific characteristics of healthcare construction environments.

To achieve this aim, the study addresses the following research questions:

1. How is risk management currently conducted in healthcare construction projects?
2. What types of risks are most critical and recurring in these projects?
3. What organisational and procedural factors influence the effectiveness of risk management practices?
4. How can a proactive risk management framework be developed to support early risk identification and decision-making in healthcare construction projects?

These research questions guide the theoretical development, empirical investigation, and framework design presented in this thesis.

1.4 Scope and Limitations

This study focuses on risk management within healthcare construction and renovation projects carried out in public sector contexts. The research primarily addresses risks related to project planning, design coordination, construction execution and the interaction between construction activities and ongoing healthcare operations.

The study focuses on organisational, project management perspectives and does not include detailed technical engineering analysis or quantitative financial risk modelling. Legal risk analysis and contractual risk allocation are addressed only at a conceptual level. The intention is to investigate how risk management processes function from a management and decision making perspective rather than from a purely technical or legal viewpoint.

As the study is conducted within a specific healthcare construction context, the findings may not be directly generalisable to all construction projects. However, the results are expected to provide transferable insights for similar public sector and healthcare related construction environments.

Finally, the study aims to develop a practical and conceptually grounded framework for proactive risk management rather than to create or test quantitative predictive models. The focus is therefore on supporting improved decision-making, communication, and organisational learning.

2 Theoretical Framework

This chapter presents the theoretical foundations that guide this study. The purpose of the theoretical framework is to provide concepts and perspectives that help analyse current risk management practices in healthcare construction projects and to support the development of a proactive risk management framework.

2.1 Organisational Risk Management

Risk management at the organisational level focuses on how organisations understand, structure and govern uncertainty in relation to their objectives. According to ISO 31000, risk is defined as the effect of uncertainty on objectives, meaning that risk management is not only about avoiding negative outcomes but also about supporting informed decision making (ISO, 2018). This definition highlights that risk management should be integrated into organisational processes rather than treated as an isolated activity. Recent studies also emphasise that organisations increasingly integrate enterprise risk management into governance structures in order to improve strategic decision making and resilience in complex project environments (Marle & Gidel, 2021; Li et al., 2022).

Organisational risk management theory emphasises that effective risk management requires leadership commitment, clear governance structures and defined roles and responsibilities. Risk management should be embedded into organisational culture and decision making processes. In this perspective, risk management becomes a management system that supports strategic goals and organisational learning. The framework proposed by ISO 31000 reflects this thinking by presenting risk management as a continuous and iterative process involving identification, analysis, treatment and monitoring of risks (ISO, 2018; El-Sayegh et al., 2021).

Another important concept within organisational risk management theory is risk culture. Risk culture refers to shared values, behaviours and attitudes towards risk within an organisation. A strong risk culture supports proactive identification of uncertainties, open communication and continuous improvement. Conversely, a weak risk culture may result in risk management becoming a formal exercise focused on documentation rather than real decision support. Recent research in construction management confirms that ineffective organisational support and weak risk culture remain common barriers to effective risk management implementation in complex projects (Taroun & Yang, 2022).

Enterprise risk management research emphasises that risk governance structures influence how information flows within organisations and how uncertainties are escalated to decision makers. Contemporary studies highlight that effective risk governance improves coordination, transparency and accountability in project based organisations (Klakegg et al., 2021; Marle & Gidel, 2021). Institutional perspectives also suggest that organisations may adopt formal risk management structures to meet regulatory expectations and demonstrate legitimacy, even if implementation practices differ across projects (Li et al., 2022).

For this study, organisational risk management theory is important because healthcare construction projects are often carried out within public or large property owning

organisations that hold long term responsibility for healthcare facilities. Risk management in such contexts must therefore be understood not only from a project perspective but also from an organisational perspective. Strategic objectives, governance structures, regulatory requirements and internal processes influence how risks are identified, evaluated and managed. In healthcare construction environments, decisions taken at the organisational level may directly affect project priorities, resource allocation and risk tolerance. Consequently, risk management cannot be analysed solely as a project level activity but must be viewed as part of a broader organisational system that shapes how uncertainty is handled across projects and over time (Olanrewaju & Babarinde, 2021).

2.2 Project Based Risk Management

While organisational theory explains how risk management is structured at a strategic level, project based risk management theory focuses on how risks are managed within individual projects. Construction projects are temporary organisations with specific goals, timeframes and stakeholders which creates unique risk management challenges (El-Sayegh et al., 2021).

Project based risk management theory builds on the idea that risks should be managed continuously throughout the project lifecycle. According to the Project Management Institute, project risk management includes processes such as risk planning, identification, analysis, response planning and monitoring (PMI, 2021). This approach highlights that risk management is not a one time activity performed at project initiation but a continuous process that evolves as the project develops. Recent research confirms that continuous risk monitoring improves project performance and helps organisations respond to uncertainties in dynamic project environments (Taroun & Yang, 2022).

A key concept within project based risk management is risk identification through collaboration. Construction projects involve multiple disciplines and risks often emerge at interfaces between different actors. Therefore, collaborative methods such as risk workshops and cross disciplinary reviews are considered essential for identifying risks early. Another central concept is risk prioritisation, where risks are assessed based on likelihood and impact to support effective decision making and resource allocation (Li et al., 2022).

Project based theory also introduces the distinction between reactive and proactive risk management. Reactive approaches focus on addressing problems after they occur, while proactive approaches aim to detect early warning signals and prevent problems from developing. Early warning indicators may include frequent design changes, coordination issues or delays in decision making. Research indicates that proactive risk management improves project performance especially in complex construction environments (Marle & Gidel, 2021).

Risk assessment methods in construction projects range from qualitative probability impact matrices to more advanced modelling techniques such as Monte Carlo simulation and fuzzy logic approaches. However, research indicates that simpler qualitative tools remain dominant in practice due to time constraints and limited data availability (El-Sayegh et al., 2021; Li et al., 2022). This gap between methodological

sophistication and practical application highlights the need for context adapted frameworks in project environments (Taroun & Yang, 2022).

In this thesis, project based risk management theory is used to analyse how risk management is currently carried out in healthcare construction projects. It also provides a foundation for developing a framework that supports practical and proactive risk management at the project level.

2.3 Healthcare Construction and Public Sector Projects

The third theoretical perspective concerns the specific context in which this study takes place: healthcare construction projects within a public sector organisation. Contextual theory emphasises that risk management practices are shaped by environmental factors, organisational structures and regulatory requirements. Recent research highlights that infrastructure and healthcare projects operate within complex institutional and regulatory environments that influence how risk management strategies are designed and implemented (Klakegg et al., 2021; Olanrewaju & Babarinde, 2021).

Healthcare construction projects represent a highly complex project environment. These projects must balance technical requirements, patient safety and ongoing healthcare operations. Construction activities often take place in operational hospitals, which means that risks related to noise, dust, interruptions of critical systems and access restrictions must be carefully managed. From a theoretical perspective, this reflects the concept of socio technical systems, where technical and organisational factors interact and influence risk outcomes. Recent studies on healthcare infrastructure projects highlight that coordination between clinical operations and construction activities is critical for maintaining operational safety and continuity (Love et al., 2021; Marzouk & Azab, 2020).

Public sector organisations introduce additional complexity. Public procurement regulations, political governance and accountability requirements may influence decision making and risk tolerance. Unlike private sector projects, public organisations often prioritise transparency and compliance alongside efficiency. This may result in structured but sometimes rigid processes which can affect flexibility in risk management. Contemporary research on public infrastructure governance emphasises that institutional frameworks and procurement rules significantly shape how risks are allocated and managed in public construction projects (Klakegg et al., 2021; Marle & Gidel, 2021).

Swedish guidelines from SKR and MSB illustrate how healthcare construction projects require increased focus on resilience, continuity of operations and coordination between stakeholders (SKR, 2019; MSB, 2018). These contextual factors suggest that generic risk management frameworks must be adapted to local conditions and organisational realities. Recent research on resilient healthcare infrastructure further highlights the importance of integrating risk management with organisational preparedness and operational resilience (World Health Organization, 2020; Love et al., 2021).

In this study, contextual theory helps explain why risk management in healthcare construction projects may differ from other construction contexts and why a tailored framework is necessary. The combination of healthcare requirements, public sector governance and project complexity creates a unique environment that influences how risks are identified, assessed and managed. Recent studies on construction risk

governance emphasise that context specific frameworks are often required to address the unique uncertainties present in complex infrastructure and healthcare projects (Taroun & Yang, 2022).

3 Literature Review

This chapter presents a review of existing literature related to risk management in construction projects with a particular focus on healthcare construction environments. The purpose of the chapter is to provide an overview of relevant theories, standards and research findings that form the academic foundation of this study. The literature review begins by discussing fundamental risk management frameworks and principles, followed by project level risk management methods and assessment techniques. Finally, the chapter examines risk management within healthcare construction and public sector contexts. Together, the reviewed literature establishes the theoretical background necessary for understanding current challenges and supporting the development of a proactive risk management approach.

3.1 Risk Management Frameworks and Principles

3.1.1 Risk and Uncertainty in Construction Projects

Construction projects are widely recognised as complex, uncertain and dynamic undertakings. Unlike standardised production processes, construction projects are temporary by nature and often involve unique designs, specific site conditions and tailored organisational structures. Each project is therefore exposed to a wide range of uncertainties that may affect its objectives related to cost, time, quality, safety and functionality. Recent studies confirm that uncertainty remains one of the defining characteristics of construction projects due to their complexity and multi stakeholder environments (El-Sayegh et al., 2021; Li et al., 2022).

Risk is commonly defined as the effect of uncertainty on objectives (ISO, 2018). In the context of construction projects, uncertainty may arise from technical challenges, incomplete or changing design information, regulatory and approval processes, market conditions, weather and organisational factors such as coordination and communication. These uncertainties are not static; rather, they evolve throughout the project lifecycle as new information becomes available and conditions change (Taroun & Yang, 2022).

Research has shown that construction projects are particularly exposed to risk due to their fragmented organisational structures. Project organisations typically consist of multiple independent actors such as clients, consultants, contractors and subcontractors each with their own objectives, responsibilities and contractual arrangements. This fragmentation increases the likelihood of interface problems, misunderstandings and information gaps which may result in errors, delays or conflicts (El-Sayegh et al., 2021).

In addition, construction projects often operate under tight time schedules and budget constraints. Decisions are frequently made under pressure which may limit the ability to thoroughly assess risks before actions are taken. Changes in scope or design are also common especially in complex projects and such changes may introduce new risks or amplify existing ones. As a result, uncertainty is an inherent characteristic of construction projects rather than an exception (Marle & Gidel, 2021).

Uncertainty management literature suggests that focusing solely on negative risks may limit innovation and opportunity realisation in projects. Moreover, complex projects often exhibit systemic risk patterns where failures emerge from interactions between technical and organisational components rather than isolated events. This systems

perspective is particularly relevant in healthcare construction contexts (Love et al., 2021).

Despite the recognised importance of risk management, several studies indicate that risk management in construction projects is often applied in a reactive manner. Risks are identified late in the project lifecycle and mitigation measures are implemented only after problems have already occurred. This reactive approach reduces the potential benefits of risk management and limits the ability of project organisations to influence outcomes proactively. Proactive risk management which focuses on early identification and continuous monitoring of risks is therefore considered essential for improving project performance (Taroun & Yang, 2022).

3.1.2 ISO 31000 as an Organisational Risk Management Frameworkres

ISO 31000 is one of the most widely adopted international standards for risk management. The standard provides general guidelines that can be applied across different sectors and organisational contexts including public organisations and construction related activities. ISO 31000 is structured around three main components: principles, framework and process (ISO, 2018).

The principles outlined in ISO 31000 emphasise that risk management should create value and contribute to achieving organisational objectives. Risk management should support decision making, be integrated into organisational processes and be systematic, structured and timely. The principles also highlight the importance of inclusiveness meaning that relevant stakeholders should be involved in risk management activities and that risk management should be transparent and based on the best available information (Marle & Gidel, 2021).

The framework component of ISO 31000 focuses on how risk management should be embedded within an organisation. This includes leadership commitment, integration into governance structures, allocation of roles and responsibilities and provision of necessary resources. Top management plays a critical role in establishing a risk aware culture and ensuring that risk management is aligned with organisational objectives. For public organisations where decision making structures are often complex this aspect of the framework is particularly important (Klakegg et al., 2021).

The risk management process described in ISO 31000 consists of several steps: risk identification, risk analysis, risk evaluation, risk treatment, monitoring, review, communication and consultation. The process is iterative and emphasises continuous improvement. Risks should be reviewed regularly and lessons learned should be used to improve future risk management practices. For organisations ISO 31000 provides a clear structure for organising risk management at an overall level and linking it to strategic planning and governance requirements (Taroun & Yang, 2022).

Figure 2. Continuous risk management process adapted to healthcare construction projects

3.1.3 Limitations of Generic Frameworks in Construction Contexts

Although ISO 31000 provides a comprehensive organisational framework several researchers argue that it is too generic to fully support risk management in construction projects. The standard intentionally avoids prescribing specific tools or methods which allows flexibility but also places responsibility on organisations to interpret and operationalise the framework (Taroun & Yang, 2022).

In construction projects where operational decisions are made daily and often under time pressure generic frameworks may be difficult to translate into practical actions. Risk management may therefore become a formal documentation exercise rather than an active management process. Risk registers may be created to fulfil organisational requirements but they are not always actively used to support decision making or follow up activities (El-Sayegh et al., 2021).

Empirical studies have identified a gap between formal risk management procedures and actual project practices. Risks are often documented at the beginning of projects but are not systematically updated or discussed as projects progress. This limits organisational learning and reduces the effectiveness of risk management (Li et al., 2022).

Another limitation of ISO 31000 is that it primarily addresses permanent organisations rather than temporary project organisations. Construction projects differ from permanent organisations in terms of structure, duration and governance. Applying an organisational risk framework to a project based environment therefore requires adaptation. These limitations suggest that ISO 31000 should be complemented by project level frameworks and practical risk assessment techniques in order to be effective in construction projects (Marle & Gidel, 2021).

3.2 Project Level Risk Management and Assessment Techniques

3.2.1 Practical Risk Assessment Methods in Construction Projects

While organisational frameworks such as ISO 31000 provide an overall structure for risk management effective implementation in construction projects requires practical tools that can be applied at the project level. Construction projects are characterised by changing conditions, time pressure and limited availability of reliable quantitative data. As a result risk assessment methods used in construction projects are often qualitative or semi quantitative in nature (Li et al., 2022).

ISO/IEC 31010 provides guidance on a wide range of risk assessment techniques that can be used depending on the context and purpose of the analysis (ISO/IEC, 2019). Commonly used techniques in construction projects include checklists, brainstorming sessions, risk workshops and probability impact matrices which support systematic identification and prioritisation of risks (Taroun & Yang, 2022).

Risk workshops are widely used in construction projects to identify and discuss potential risks collaboratively. During such workshops project participants from different disciplines contribute their perspectives which helps identify risks related to interfaces, coordination and dependencies. Although risk matrices are sometimes criticised for oversimplifying complex risks they remain widely used due to their practicality and transparency in decision making (El-Sayegh et al., 2021).

In healthcare construction projects the use of structured risk assessment methods is particularly important due to the potentially severe consequences of failures. Interruptions to ventilation, electricity or medical gas systems may directly affect patient safety and healthcare operations. Therefore more detailed techniques such as Failure Mode and Effects Analysis (FMEA) are often recommended for analysing potential system failures and preventing disruptions (Love et al., 2021).

3.2.2 Project Management Standards and Risk Processes

In addition to risk assessment techniques project management standards provide guidance on how risk management can be integrated into project workflows. The Project Management Institute's PMBOK Guide describes project risk management as a structured and continuous process that includes risk planning, identification, qualitative and quantitative analysis, response planning and monitoring (PMI, 2021).

PMBOK emphasises that risk management should be planned early in the project and continuously updated throughout the project lifecycle. Risk planning includes defining roles, responsibilities, tools and reporting routines. Risk identification involves identifying potential events that may affect project objectives while risk analysis focuses on assessing the likelihood and impact of these events (Marle & Gidel, 2021).

Compared to ISO 31000 PMBOK provides more detailed operational guidance and practical templates that are directly applicable in project environments. This makes PMBOK particularly relevant for construction projects where project managers play a central role in coordinating risk management activities (Taroun & Yang, 2022).

However research shows that the effectiveness of project level risk management processes depends on organisational support and leadership commitment. In public sector construction projects project management standards are often adapted to fit organisational requirements procurement rules and governance structures which may result in differences in how risk management is applied between projects (Klakegg et al., 2021).

3.2.3 Proactive Risk Management and Early Warning Indicators

Traditional risk management approaches in construction projects often focus on identifying risks at the beginning of a project. However research suggests that many significant risks emerge during later project phases due to design changes coordination issues or external factors (Li et al., 2022).

Proactive risk management therefore emphasises continuous risk identification and monitoring throughout the project lifecycle. Early warning indicators such as design changes delays in decision making communication breakdowns or deviations from planned schedules can signal emerging risks and allow project teams to intervene before problems escalate (Taroun & Yang, 2022).

Several studies highlight the importance of combining formal risk management tools with informal communication and learning processes. While formal tools such as risk registers provide structure informal communication supports rapid information sharing and collaborative problem solving within project teams (El-Sayegh et al., 2021).

For complex construction projects proactive risk management can significantly improve decision making and reduce the likelihood of major disruptions. This approach is particularly relevant for healthcare construction projects where failures may directly affect patient safety and operational continuity (Love et al., 2021).

3.3 Risk Management in Healthcare Construction and Public Sector Contexts

3.3.1 Characteristics of Healthcare Construction Projects

Healthcare construction projects represent one of the most complex categories of construction projects. In addition to the challenges common to all construction projects healthcare facilities rely on advanced technical systems that must function continuously including ventilation electricity medical gases water supply and digital infrastructure (Love et al., 2021).

Construction activities often take place in or near operational healthcare facilities which significantly increases the risk of disruptions to ongoing healthcare services. Patient safety therefore becomes a central concern and risks related to infection control noise vibrations air quality and access routes must be carefully managed (World Health Organization, 2020).

Another characteristic of healthcare construction projects is the involvement of a large number of stakeholders including healthcare staff facility managers construction professionals and regulatory authorities. These stakeholders may have different priorities and perspectives on risk which increases the complexity of project coordination and decision making (Olanrewaju & Babarinde, 2021).

3.3.2 Swedish Guidelines and Public Sector Requirements

In Sweden healthcare construction projects are subject to specific public sector requirements and national guidelines. Sveriges Kommuner och Regioner (SKR) has published guidance on construction activities in hospital areas focusing on risks related to noise dust vibrations and system interruptions (SKR, 2019).

The Swedish Civil Contingencies Agency (MSB) provides guidance on resilience and preparedness in healthcare buildings with particular focus on dependencies on critical infrastructure and emergency preparedness (MSB, 2018). These guidelines emphasise the importance of continuity of operations and coordination between construction and healthcare services.

Recent research on public infrastructure governance highlights that risk management in public projects must balance regulatory compliance operational requirements and stakeholder accountability which often increases project complexity (Klakegg et al., 2021).

3.3.3 Organisational Culture, Learning and International Comparison

Research shows that risk management in construction projects is often formalised through documentation such as risk registers and checklists but that follow up and organisational learning remain limited. Risks may be identified and documented but are not always actively discussed or updated as projects progress which reduces the effectiveness of risk management processes (El-Sayegh et al., 2021).

Organisational culture plays a critical role in risk management effectiveness. A culture that encourages openness learning and communication supports proactive risk management while a culture focused mainly on compliance may limit learning and innovation in project organisations (Marle & Gidel, 2021).

International comparisons show that different countries emphasise different approaches to risk management. While ISO 31000 is widely used as a general framework many organisations also rely on project management standards such as PMBOK or PRINCE2 depending on governance structures and industry practices (Taroun & Yang, 2022).

The literature therefore suggests that a hybrid approach combining organisational frameworks project level tools and context specific guidelines is particularly suitable for public healthcare construction projects. Such an approach allows organisations to address both strategic and operational risks while adapting risk management practices to local organisational and institutional conditions (Klakegg et al., 2021).

4 Method

This chapter outlines the methodological approach undertaken for data collection and analysis in order to address the study's research questions. The study adopts a qualitative research design supported by a structured literature review, enabling a comprehensive understanding of risk management practices in healthcare construction projects (Creswell & Creswell, 2018; Yin, 2018).

The methodological approach combines theoretical insights from existing research with empirical data collected through semi structured interviews with professionals working in healthcare construction projects. This combination allows the study to explore both how risk management is described in theory and how it is applied in practice (Saunders et al., 2019).

The overall aim of the methodology is to ensure that the findings are both academically grounded and practically relevant. By integrating literature with empirical data, the study seeks to provide a nuanced understanding of current risk management practices, challenges and opportunities for improvement (Snyder, 2019).

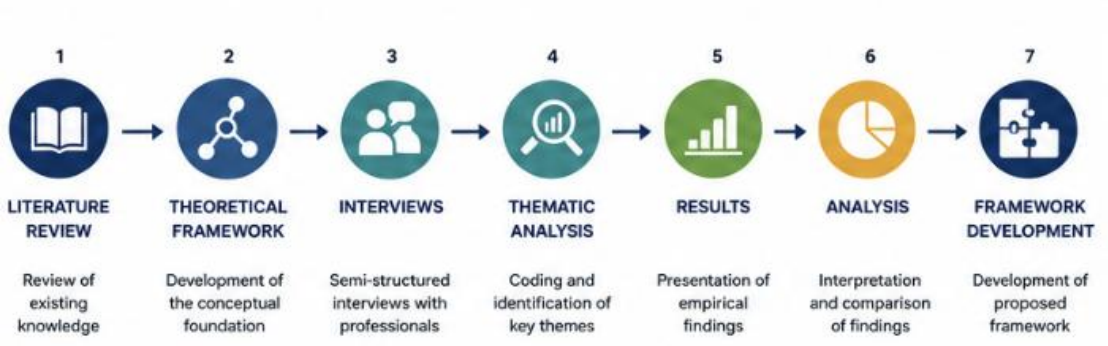

Figure 1. Research process the study

4.1 Literature Review

To establish a theoretical foundation for the study, a structured literature review was conducted. The purpose of the literature review was to identify relevant theories, frameworks and previous research related to risk management in construction projects with a particular focus on healthcare environments and public sector contexts (Paul et al., 2021).

The literature review followed a systematic approach inspired by established methodologies for academic reviews ensuring transparency and consistency in the selection process. Scientific databases such as Scopus, Web of Science and Google Scholar were used to identify relevant sources. In addition, institutional databases and university library resources were used to access peer reviewed journal articles, books and reports (Snyder, 2019).

The search process began with broad keywords related to the research topic, such as "risk management," "construction projects," "healthcare construction," and "project

risk." This initial search generated a large number of results, many of which were too general or not directly relevant to the research focus.

To improve relevance, the search strategy was refined by combining keywords using Boolean operators. More specific search terms were introduced such as "risk management AND healthcare construction," "project risk management AND construction industry," and "ISO 31000 AND construction projects." (Snyder, 2019). Additional terms such as "uncertainty management," "project complexity," and "public sector construction" were added iteratively as patterns emerged in the literature.

To ensure quality and relevance, inclusion and exclusion criteria were applied. Sources were included if they were peer reviewed, published in English and directly related to risk management, construction projects or healthcare infrastructure. Priority was given to more recent publications to reflect current practices and developments while some foundational sources were included to provide theoretical context (Paul et al., 2021).

Sources were excluded if they lacked methodological clarity, were not relevant to construction or risk management or focused on unrelated industries. Grey literature was used selectively, mainly for national guidelines and reports relevant to healthcare construction contexts.

The literature review process was iterative, meaning that sources were continuously evaluated and refined throughout the research process. The selected literature formed the basis for the theoretical framework and supported the development of interview questions. It also provided a reference point for interpreting empirical findings in later stages of the study.

4.2 Research Design and Approach

This study adopts a qualitative research approach to explore how risk management is conducted in healthcare construction projects and to identify challenges and opportunities for improvement. A qualitative approach is appropriate for this study because it allows for an in depth understanding of complex processes, behaviours and experiences that cannot be fully captured through quantitative methods (Creswell, 2018).

The research design is exploratory in nature, as it aims to investigate current practices and identify patterns rather than test predefined hypotheses. The focus is on understanding how risk management is perceived and applied by professionals working in real project environments (Yin, 2018).

The study is based on a case oriented perspective, where healthcare construction projects are treated as a specific context characterised by high complexity, multiple stakeholders and strict operational requirements. By focusing on this context, the study aims to generate insights that are both context specific and relevant for similar types of projects.

The qualitative approach also allows flexibility in data collection, enabling the researcher to explore emerging themes and adapt questions based on respondents' experiences. This is particularly important in studies dealing with complex and dynamic topics such as risk management (Saunders et al., 2019).

4.3 Interview Study

4.3.1 Selection of Respondents

The empirical data in this study was collected through semi structured interviews with professionals involved in healthcare construction projects. The respondents were selected based on their experience and involvement in relevant projects ensuring that they could provide valuable insights into risk management practices (Etikan & Bala, 2017).

A purposive sampling strategy was used, meaning that respondents were chosen based on their relevance to the research topic rather than through random selection. The aim was to include a range of roles within the project organisation in order to capture different perspectives.

The respondents included project managers, construction managers, site supervisors, work environment specialists and senior professionals from contractor organisations. This diversity allowed the study to capture both strategic and operational perspectives on risk management.

In total, six interviews were conducted. The respondents are referred to as Respondent 1–6 in order to ensure anonymity.

4.3.2 Interview Design

The interviews were semi structured, meaning that they were guided by a set of predefined questions while allowing flexibility for follow up questions and deeper exploration of specific topics. This approach enabled the researcher to maintain focus on the research questions while also capturing new insights that emerged during the interviews (Adams, 2015; Saunders et al., 2019).

The interview guide was developed based on the literature review and the research questions. The questions were designed to explore key areas such as:

- Current risk management practices
- Types of risks encountered in healthcare construction
- Challenges in managing risks
- Opportunities for improving risk management

Open ended questions were used to encourage detailed responses and allow respondents to share their experiences in their own words. This approach provided rich qualitative data and allowed for a deeper understanding of how risk management is applied in practice (Castleberry & Nolen, 2018).

4.3.3 Data Collection

The interviews were conducted over a period of several weeks and lasted between 30 and 60 minutes. Most interviews were conducted digitally using Microsoft Teams while some were conducted in person depending on availability.

Digital interviews provided flexibility and made it easier for respondents to participate despite busy schedules. However, it is acknowledged that online interviews may limit the ability to observe non verbal communication and build rapport (Archibald et al., 2019). To address this, efforts were made to create a comfortable and open interview environment by clearly explaining the purpose of the study and encouraging honest and reflective responses.

All interviews were recorded with the consent of the respondents. Recording ensured that the data could be accurately transcribed and analysed. Notes were also taken during the interviews to capture key points and reflections.

4.3.4 Data Analysis

The collected data was analysed using a qualitative thematic analysis approach. The purpose of the analysis was to identify patterns, themes and relationships within the data that are relevant to the research questions. The analysis process involved several steps. First, the interviews were transcribed to create a textual dataset. The transcripts were then carefully reviewed multiple times to gain familiarity with the content (Braun et al., 2019).

Next, the data was coded by identifying key statements, concepts and recurring topics. These codes were then grouped into broader themes that represent common patterns across the interviews.

The main themes identified in the analysis include:

- Risk management practices
- Key risk types
- Challenges affecting risk management
- Conditions for improvement

These themes form the structure of the results chapter. The analysis focused on identifying similarities and differences between respondents and understanding how different factors influence risk management practices.

The use of thematic analysis allows for a systematic and transparent interpretation of qualitative data while maintaining flexibility to capture complex and context specific insights (Braun et al., 2019).

4.4 Reliability and Validity

Ensuring the reliability and validity of the study is an important aspect of the research process. In qualitative research, reliability refers to the consistency of the research process while validity refers to the accuracy and credibility of the findings (Yin, 2018).

To enhance reliability, a structured and transparent methodology was used throughout the study. The interview guide was carefully designed and all interviews followed a similar structure. The data analysis process was systematic with clear steps for coding and theme development.

To improve validity, multiple respondents with different roles and perspectives were included. This allowed for triangulation where findings could be compared across different viewpoints. The use of direct quotations in the results also helps to ensure that interpretations are grounded in the data (Creswell & Creswell, 2018).

Additionally, the combination of literature review and empirical data strengthens the validity of the study by linking theoretical concepts with real world practices.

4.5 Sustainability

Although the primary focus of this study is risk management, sustainability is also closely connected to healthcare construction projects. Sustainable construction is not only related to environmental performance but also to operational continuity, resilience and long term functionality (United Nations, 2023).

In healthcare environments, ineffective risk management may lead to delays, rework, disruptions of healthcare operations and unnecessary use of resources. By improving proactive risk management, organisations may reduce waste, improve coordination and minimise operational disruptions during construction activities (Love et al., 2021; Martek et al., 2022).

The study therefore considers sustainability from both an organisational and operational perspective. A proactive risk management approach can contribute to more resilient healthcare infrastructure, improved resource efficiency and more sustainable project delivery over time. This is particularly important in public healthcare projects where buildings must support long term societal functions and continuous healthcare operations.

4.6 Ethical Considerations

Ethical considerations were an important part of the research process. The study followed established ethical guidelines to ensure that respondents were treated with respect and that their data was handled responsibly (Fleming & Zegwaard, 2018).

All respondents were informed about the purpose of the study, how the data would be used and their right to withdraw at any time. Verbal consent was obtained before conducting the interviews (Castleberry & Nolen, 2018).

Anonymity was ensured by not including names or identifiable information in the study. Respondents are referred to using general titles (e.g., Respondent 1–6) and any sensitive information has been removed or generalised.

The study also follows GDPR principles for data protection. Interview recordings and transcripts were handled securely and used only for research purposes. After completion of the study, sensitive data was deleted (European Commission, 2020).

To support transcription and language processing, digital tools such as AI-based software were used. However, no confidential or identifiable information was shared with these tools. All data was anonymised prior to processing.

By following these ethical principles, the study aims to ensure transparency, protect respondents' rights and maintain the integrity of the research process.

5 Empirical Results

5.1 Current Risk Management Practices in Healthcare Construction Projects

The empirical findings indicate that risk management in healthcare construction projects is formally established and systematically initiated during the early stages of projects, but its application becomes less structured as projects progress into execution. This pattern is consistently observed across all interviewees, regardless of their role within the project organisation.

During the planning and design phases, risk management is primarily conducted through structured processes such as risk workshops, formal assessments and documentation in risk registers. These activities are typically organised by project management and involve multiple stakeholders, including consultants, engineers and sometimes representatives from healthcare operations. The purpose of these processes is to identify and categorise risks related to technical systems, coordination, safety, and the impact on ongoing healthcare services.

At this stage, risk management is perceived as comprehensive and methodical. Risks are discussed collaboratively and the structured format allows different perspectives to be included in the assessment. The use of risk registers provides an overview of identified risks and proposed mitigation measures contributing to a shared understanding of potential uncertainties. This is supported by Respondent 1, who explained that *"in the early stages, we have structured workshops where we go through risks together with the team and try to cover different perspectives."*

However, the findings show that the role of these formal tools decreases significantly during the construction phase. Risk registers are not consistently updated and are rarely used as active decision support tools during execution. Instead, they tend to remain as static documentation from earlier project phases.

As one respondent noted, risk management is "quite structured in the beginning but during construction it becomes more about handling issues when they occur" (Respondent 6). This shift illustrates a clear transition from proactive planning to reactive problem solving.

During execution, risk management becomes more closely integrated with daily operations but in a less formalised way. Site level actors rely on meetings, direct communication and on site observations to identify and manage risks. Decisions are often made in real time based on current conditions rather than predefined risk management processes.

This operational approach reflects the dynamic nature of construction projects, where unexpected situations frequently arise. However, it also reduces the level of structure and consistency in risk management practices. Risks are often managed as isolated issues rather than as part of a continuous and systematic process. As described by

Respondent 3, *"on site, we mostly handle risks when they appear rather than following a structured system."*

A key aspect of this transition is the increasing reliance on experience. The findings show that experienced professionals play a central role in identifying risks and making decisions during execution. Practical knowledge is used to interpret situations, anticipate potential issues and respond to emerging challenges.

This reliance on experience is particularly important in healthcare construction projects, where complexity and uncertainty are high. Formal tools alone are not sufficient to capture all potential risks, especially those related to system interactions and operational constraints. As Respondent 4 noted, *"experience is crucial, because many risks are not visible in documents but become clear in practice."*

At the same time, this creates variability in practices. The effectiveness of risk management depends on the competence and engagement of individuals rather than on standardised processes. Projects with more experienced teams tend to manage risks more effectively while less experienced teams may struggle to identify and respond to emerging issues.

Another important finding is that risk management is not fully integrated into daily project management processes. Although risks are discussed in meetings, they are not always explicitly linked to decision making. Instead, risk discussions often occur alongside other project activities without being systematically incorporated into planning or control mechanisms.

This limits the ability of risk management to influence project outcomes. When risks are not clearly connected to decisions, they may be acknowledged but not acted upon in a structured way. As Respondent 5 described, *"we talk about risks, but it is not always clear how they actually affect decisions."*

Overall, the results show that current risk management practices are characterised by a structured initial approach combined with informal and experience based practices during execution. This fragmentation limits the ability to maintain a consistent and proactive approach throughout the project lifecycle.

5.2 Key Risk Types and Critical Areas in Healthcare Construction

The interviews highlight several types of risks that are particularly significant in healthcare construction projects. These risks are closely related to the complexity of the project environment and the requirement to maintain ongoing healthcare operations during construction activities. Compared to conventional construction projects, the consequences of failures in this context are often more severe, as they may directly affect patient safety, healthcare staff, and critical services.

Figure 3. Main risk categories identified in the empirical findings

One of the most critical categories of risk identified is related to technical systems. Healthcare facilities depend on a wide range of advanced and interconnected systems, including ventilation, electrical systems, medical gases, water supply, and IT infrastructure. These systems must function continuously, even during construction work, which creates significant constraints for project execution.

The findings show that risks associated with these systems are difficult to fully anticipate during the planning phase. Although technical designs aim to define system behaviour, the actual conditions encountered during construction often reveal additional complexities. System dependencies mean that changes in one component may influence several others, sometimes in unexpected ways. As a result, risks are not limited to individual systems but arise from the interactions between them.

This complexity is reflected in the statement from Respondent 4, who emphasised that *"the biggest risks are not the systems themselves, but how they affect each other when changes are made."* This highlights that risk management in healthcare construction must consider the system as a whole rather than focusing on isolated components.

Another important category of risk is related to coordination and interfaces between stakeholders. Healthcare construction projects involve a large number of actors, including clients, contractors, consultants, subcontractors, and healthcare staff. Each of these actors has different roles, responsibilities, and priorities, which creates a complex organisational environment.

The findings indicate that many risks emerge at the interfaces between these actors. Miscommunication, lack of information sharing, and differing interpretations of technical requirements can lead to errors, delays, and rework. These issues are often not identified during early planning stages but become visible during execution, when coordination between actors becomes critical.

This challenge is clearly reflected in the statement from Respondent 2, who noted that *"many risks come from misunderstandings between different actors rather than from technical issues."* This suggests that organisational and communication-related factors are just as important as technical factors in understanding project risks.

Operational risks related to ongoing healthcare activities are also highly significant. Construction work in healthcare environments must be carried out without disrupting critical operations, which places strict requirements on planning and execution. Risks related to noise, dust, vibrations, and access to facilities must be carefully managed to avoid negative impacts on patients and staff.

The findings show that these operational risks are particularly challenging because they are closely linked to real-time conditions in the healthcare environment. For example, construction activities may need to be adjusted depending on patient flows, emergency situations, or changes in healthcare operations. This creates a dynamic context where risks are continuously evolving and difficult to fully control.

Furthermore, the consequences of operational risks can be severe. Interruptions to ventilation systems, power supply, or medical gases can directly affect patient safety and the ability of healthcare staff to perform their work. This increases the importance of early identification and careful coordination, but also highlights the limitations of static risk management approaches.

Another important category of risk is related to time and scheduling. Healthcare construction projects often operate under strict time constraints due to the need to coordinate construction activities with ongoing healthcare services. Work may only be allowed during specific time periods, such as evenings or weekends, which limits flexibility and increases pressure on project teams.

This constraint creates additional challenges for risk management. Limited time windows reduce the opportunity for thorough preparation and increase the likelihood of errors. When delays occur, there is often little flexibility to adjust the schedule, which can lead to cascading effects on other project activities.

As described by Respondent 3, *"we often have limited time windows, which makes it difficult to plan everything and increases the pressure during execution."* This illustrates how scheduling constraints contribute to increased uncertainty and reduced ability to manage risks proactively.

The findings also highlight risks related to organisational and governance structures. In projects involving multiple stakeholders, responsibilities are not always clearly defined, which can lead to uncertainty regarding who is responsible for managing specific risks. This lack of clarity can result in delayed actions and reduced accountability.

In addition, formal governance structures, particularly in public sector projects, influence how risks are managed. Decision-making processes may involve multiple levels of approval, which can slow down responses to emerging risks. While these structures are important for ensuring accountability and compliance, they may also limit flexibility and responsiveness during critical project phases.

Another aspect related to organisational risks is the variation in risk perception among different stakeholders. Actors with different roles may prioritise risks differently based on their own responsibilities and objectives. For example, contractors may focus on time and cost risks, while healthcare staff prioritise operational and safety risks. These differing perspectives can create challenges in aligning priorities and managing risks in a coordinated way.

Overall, the findings show that risk types in healthcare construction projects are diverse and highly interconnected. Technical, operational, coordination, scheduling, and organisational risks interact in complex ways, creating a challenging environment for risk management.

These risks cannot be understood or managed in isolation, as they are influenced by both project-specific conditions and broader organisational factors. This complexity highlights the need for comprehensive and integrated approaches to risk management that consider both technical and organisational dimensions.

5.3 Challenges Affecting Risk Management Effectiveness

The findings identify several challenges that significantly affect the effectiveness of risk management in healthcare construction projects. These challenges are closely related to the research problem of why risk management is not always proactive and effective in practice. Rather than being isolated issues, the challenges are interconnected and emerge from the interaction between project conditions, organisational structures and human factors.

One of the most prominent challenges is the gap between planning and execution. While risks are identified in detail during early project phases, their management during construction is less consistent. Mitigation measures that are defined during planning are not always implemented in practice and risks that were previously identified may reappear during execution. This suggests that risk management is not fully transferred from planning into operational activities.

This gap is clearly described by Respondent 6, who explained that *"there is often a difference between what is planned and what is actually implemented on site."* Several respondents emphasised that this discrepancy is not necessarily due to a lack of knowledge but rather due to changing conditions, practical limitations and the complexity of real project environments. As construction progresses, new information becomes available and previously defined plans may no longer be fully applicable. This creates a situation where project teams must continuously adapt often without systematically updating risk management documentation or processes.

Another major challenge is the reactive nature of risk management. Although there is a clear intention among project actors to work proactively, the findings show that many risks are addressed only after they become visible during construction. Instead of preventing risks, project teams often focus on solving problems once they occur. This reactive approach limits the potential benefits of risk management and reduces its impact on project outcomes.

Time pressure is a key factor contributing to this behaviour. Healthcare construction projects are typically carried out under strict scheduling constraints as construction activities must be coordinated with ongoing healthcare operations. This means that work often has to be performed within limited time windows, which reduces flexibility and increases pressure on project teams. Under these conditions, there is often insufficient time to conduct detailed risk assessments or to follow up on previously identified risks.

As Respondent 3 noted, *"you often have to act quickly, which means you solve problems instead of preventing them."* This highlights how time constraints influence decision making and encourage short term solutions rather than long term risk mitigation strategies.

The complexity of healthcare environments further complicates risk management. These projects involve highly technical systems that are critical for hospital operations such as ventilation, electrical systems and medical gas infrastructure. These systems are not only complex in themselves but are also interconnected meaning that changes in one system may affect several others.

This creates situations where risks are difficult to fully predict during the planning phase. Even when risks are identified, their full implications may not be understood until construction is underway. As a result, unexpected issues frequently arise, requiring immediate responses and continuous adjustments. This ongoing uncertainty challenges the effectiveness of structured risk management approaches.

Coordination challenges also play a significant role in influencing risk management effectiveness. Healthcare construction projects involve a large number of stakeholders, including clients, contractors, consultants and healthcare staff. Each of these actors has different responsibilities, objectives and perspectives which makes coordination complex.

The findings show that many risks originate at the interfaces between these actors. Miscommunication, lack of information sharing and differing interpretations of project requirements can lead to misunderstandings and errors. These issues may not be identified during early planning phases but emerge during execution, when coordination becomes critical. As a result, risk management is heavily dependent on the quality of communication and collaboration between stakeholders.

Unclear responsibilities are another important challenge. When it is not clearly defined who is responsible for managing specific risks, actions may be delayed or not taken at all. Several respondents indicated that this is particularly problematic in projects involving multiple contractors and subcontractors, where responsibilities are distributed across different organisations.

This lack of clarity can lead to situations where risks "fall between" actors, as no single party takes ownership. Consequently, risk management becomes less effective as identified risks are not followed up or managed in a coordinated way.

Organisational factors, such as governance structures and decision making processes, also influence risk management. In public sector projects, decision making often

involves multiple levels of approval which can slow down responses to emerging risks. While these structures are designed to ensure accountability and compliance, they may also reduce flexibility and responsiveness.

Several respondents highlighted that delays in decision making can create uncertainty and increase risk, particularly during the execution phase where quick actions are often required. This creates a tension between formal governance requirements and the need for efficient risk management.

Finally, organisational culture plays an important role in how risks are identified and managed. The findings indicate that a culture characterised by openness and communication supports more effective risk management. When individuals feel comfortable sharing concerns and reporting issues, risks are more likely to be identified at an early stage.

In contrast, in environments where communication is limited or where there is a strong focus on avoiding mistakes, risks may not be reported until they become critical. As highlighted by Respondent 2, *"if people do not speak up, risks are discovered too late."* This illustrates how cultural factors influence the flow of information and the ability to manage risks proactively.

Overall, these challenges demonstrate that risk management effectiveness in healthcare construction projects is influenced by a combination of technical complexity, organisational structures and human factors. The interaction between these elements creates a complex environment where maintaining a proactive and consistent approach to risk management is difficult.

5.4 Conditions for Improving and Enabling Proactive Risk Management

The findings indicate several conditions that are necessary for improving risk management practices and enabling a more proactive approach in healthcare construction projects. These conditions are directly linked to the research aim of identifying how risk management can be improved in practice and reflect both organisational and project level requirements.

One of the most important conditions identified is the need for continuous risk management throughout the project lifecycle. The results show that current practices are heavily focused on the early stages of projects, particularly during planning and design, while risk management during execution is less structured. This creates a discontinuity where risks identified early are not consistently followed up or managed as the project progresses.

To address this issue, respondents emphasise the importance of integrating risk management into all stages of the project including construction and handover. Continuous monitoring and regular updates are necessary to capture new risks and adapt to changing conditions. As Respondent 1 emphasised, *"risk management should not stop after the planning phase, it needs to continue during the whole project."* This

highlights the need to move from a one time assessment approach to a dynamic and ongoing process.

Another key condition is the early involvement of stakeholders. The findings show that risk identification is significantly improved when a broader range of actors is involved from the beginning of the project. This includes not only project managers and consultants but also site personnel and representatives from healthcare operations.

These actors contribute different types of knowledge, particularly practical and operational insights that may not be captured in formal planning processes. For example, site personnel can identify risks related to constructability and working conditions, while healthcare staff can highlight risks related to patient safety and operational disruptions. Early involvement therefore supports a more comprehensive understanding of risks and reduces the likelihood of overlooking critical issues.

Improved integration between project phases is also identified as an essential condition for proactive risk management. The findings indicate that there is often a disconnect between design, planning and execution phases. Risks identified during early phases are not always effectively communicated or managed during construction which contributes to the gap between planning and implementation.

Strengthening the connection between these phases would improve continuity and ensure that risk management remains relevant throughout the project. This requires structured handovers, better documentation practices, and more consistent communication between different project actors. By ensuring that risk-related information is transferred and actively used across phases, projects can reduce uncertainty and improve coordination.

Clear responsibilities and accountability are also identified as critical enablers. The findings show that unclear ownership of risks is a recurring issue that reduces the effectiveness of risk management. When it is not clearly defined who is responsible for managing a specific risk, actions may be delayed or not taken at all.

Establishing clear roles and responsibilities ensures that risks are actively managed and followed up. It also improves accountability and supports more efficient decision-making. As Respondent 5 stated, *"when responsibilities are clear, it is much easier to manage risks."* This highlights the importance of organisational clarity in enabling proactive risk management.

Communication and collaboration are also central conditions. The findings indicate that effective communication between stakeholders improves coordination and reduces the likelihood of misunderstandings. Regular meetings, open dialogue and transparent information sharing are important for identifying risks early and ensuring that relevant information is available to all actors.

Collaboration is particularly important in healthcare construction projects, where multiple stakeholders with different perspectives are involved. By working collaboratively, project teams can better understand interdependencies and address risks before they escalate.

Another important condition is organisational learning. The findings show that lessons learned from previous projects are not always systematically captured or applied in future projects. This limits the ability to improve risk management practices over time.

Respondents emphasised the importance of creating structured processes for capturing and sharing knowledge. This includes documenting experiences, analysing previous risks and integrating lessons learned into future projects. By improving knowledge transfer, organisations can enhance their ability to anticipate risks and avoid repeating past mistakes.

Finally, digital tools are identified as potential enablers for improving risk management. Tools that support continuous tracking, documentation and communication of risks can improve transparency and provide better support for decision making. However, the findings indicate that digital tools are only effective if they are integrated into daily project activities.

If tools are perceived as separate or overly complex, they are unlikely to be used consistently. Therefore, usability and integration are key factors in ensuring that digital solutions support rather than hinder risk management practices.

Overall, the findings suggest that improving risk management in healthcare construction projects requires a shift from a static, planning focused approach to a continuous, integrated and collaborative process. This process must involve all relevant stakeholders, be embedded in daily project activities and support proactive decision making throughout the project lifecycle.

6 Analysis

This chapter analyses the empirical findings in relation to the theoretical framework and literature review. The purpose of the analysis is to interpret the results and answer the research questions by identifying patterns, relationships and underlying explanations for current risk management practices in healthcare construction projects.
The analysis is structured into four main sections corresponding to the key themes identified in the results:

1. Risk management practices
2. Key risk types
3. Challenges affecting effectiveness
4. Conditions for proactive risk management

These themes are analysed in relation to organisational risk management theory, project based risk management and contextual factors specific to healthcare construction.

6.1 Analysis of Current Risk Management Practices

The findings demonstrate that risk management in healthcare construction projects is characterised by a clear shift between project phases. In the early stages, particularly during planning and design, risk management is carried out through structured and formalised processes. These include risk workshops, documentation in risk registers and collaborative assessments involving multiple stakeholders. However, as projects move into the execution phase, this structured approach gradually diminishes and is replaced by more informal, reactive and experience based practices.

This transition reflects a fundamental challenge that has been widely discussed in the literature: the gap between theoretical frameworks and practical implementation. From a theoretical standpoint, frameworks such as ISO 31000 and PMBOK emphasise that risk management should be continuous, iterative and integrated into all phases of the project lifecycle. Risk management is not intended to be a one time activity but rather a dynamic process that evolves alongside the project. Despite this, the empirical findings indicate that risk management in practice is often front loaded, meaning that the majority of structured activities occur early in the project while later phases rely less on formal processes.

This suggests that organisational risk management principles are only partially implemented. According to organisational theory, risk management should be embedded within decision making processes and organisational routines. It should actively influence how decisions are made, particularly in uncertain and complex environments. However, the findings indicate that risk management is not consistently integrated into daily project management during execution. Instead, it tends to operate alongside project activities rather than being fully embedded within them.

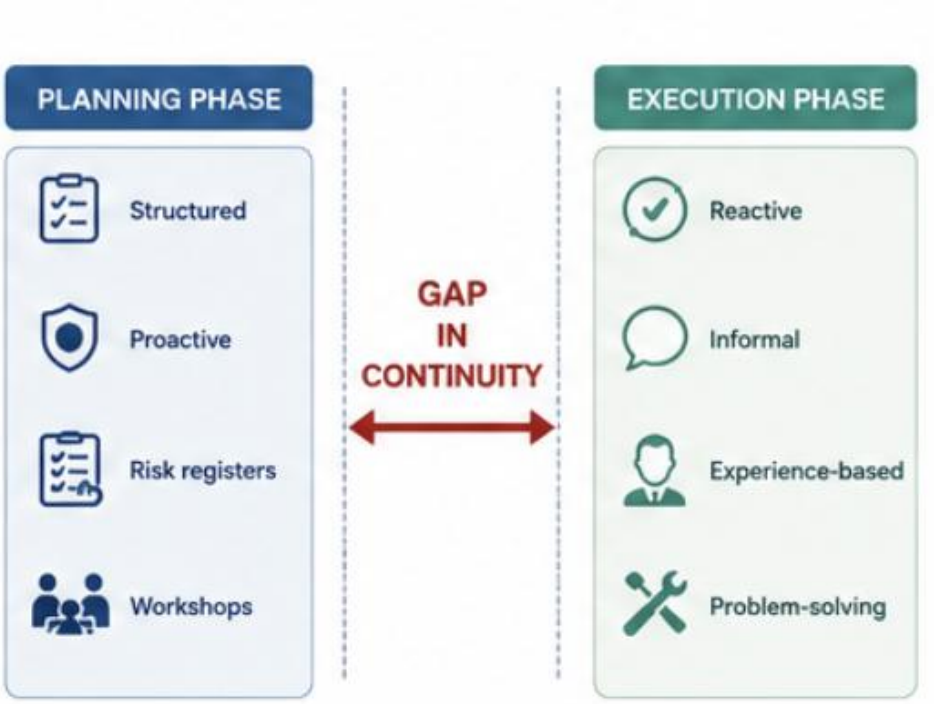

Figure 4. Identified gap between formal risk planning and practical execution

This phenomenon can be understood through the concept of decoupling, where formal systems and procedures exist but are not effectively connected to actual practice. In this case, tools such as risk registers and structured assessments fulfil formal and organisational requirements but their practical use as decision support mechanisms is limited during the construction phase. Rather than being actively used to guide decisions, they often remain static documents created earlier in the project.

A key aspect of this shift is the increasing reliance on experience and tacit knowledge during execution. The findings show that project actors, particularly those working on site, depend heavily on their own judgement and previous experience when identifying and managing risks. While this form of knowledge is valuable and often necessary in complex environments, it introduces variability into the process. Risk management becomes dependent on individual competence rather than standardised procedures which can lead to inconsistencies between projects and teams.

From a project based risk management perspective, this represents a deviation from recommended practices. Structured processes are designed to ensure that risks are systematically identified, analysed and monitored. When these processes are replaced by informal practices, the ability to maintain a consistent and transparent approach to risk management is reduced. At the same time, the findings suggest that this shift is not entirely avoidable but rather a response to the realities of construction projects.

Construction environments, particularly in healthcare contexts are inherently dynamic and unpredictable. Conditions change frequently and unexpected issues often arise during execution. In such situations, formal processes may be perceived as too rigid or time consuming, limiting their usefulness in real time decision making. As a result,

project teams prioritise speed and flexibility, relying on direct communication and immediate problem solving rather than structured risk management tools.

This highlights an important tension between structure and flexibility. On one hand, structured risk management processes are necessary to ensure consistency, documentation and proactive planning. On the other hand, the dynamic nature of construction projects requires flexibility and rapid decision making. The findings suggest that current practices tend to prioritise flexibility during execution often at the expense of structure.

However, this imbalance has important implications for risk management effectiveness. While flexible and experience based approaches allow project teams to respond quickly to emerging issues, they also reduce the ability to anticipate and prevent risks. Without continuous monitoring and systematic follow-up, previously identified risks may be overlooked and new risks may not be detected early enough. This reinforces a reactive approach, where risks are addressed after they have materialised rather than being managed proactively.

Another important observation is that risk management is not always clearly linked to decision making processes. Although risks are discussed in meetings and informal interactions, they are not consistently integrated into planning, scheduling or resource allocation decisions. This limits the strategic role of risk management and reduces its impact on project outcomes. In theory, risk management should support informed decision making by providing a structured understanding of uncertainties. In practice, however this connection appears to be weak.

Overall, the analysis shows that current risk management practices in healthcare construction projects are characterised by a dual structure. On one level, there is a formal system that aligns with theoretical frameworks and organisational requirements. On another level, there is an informal system based on experience, communication and real time problem solving. The interaction between these two systems creates a fragmented approach where risk management is not consistently applied throughout the project lifecycle.

6.2 Analysis of Key Risk Types and Critical Areas

The results identify technical, coordination, operational, scheduling and organisational risks as the most critical in healthcare construction projects. While these categories are also commonly discussed in the broader construction management literature, the findings suggest that their characteristics and interactions differ significantly in healthcare environments. Rather than existing as separate categories, these risks are closely interlinked and often reinforce each other, creating a complex and dynamic risk landscape. This is consistent with previous research emphasising that risks in construction projects are multidimensional and interconnected (Zou et al., 2007; Chapman & Ward, 2011).

From a systems perspective, the prominence of technical risks highlights the central role of interdependencies in healthcare construction. Healthcare facilities rely on highly integrated technical systems that must operate continuously even during construction activities. Unlike conventional construction projects, where systems can often be installed or modified without affecting ongoing operations, healthcare

environments require uninterrupted functionality. This creates a situation where even minor interventions can have cascading effects across multiple systems.

This observation aligns with the concept of socio technical systems where risks emerge not only from technical components but also from their interaction with organisational processes and human actions.The findings clearly indicate that risks are rarely confined to a single system. Instead, they arise through the interaction between systems, particularly when modifications are made during construction. As highlighted by Respondent 4, “the biggest risks are not the systems themselves, but how they affect each other when changes are made.” This challenges traditional risk management approaches that focus on identifying isolated risks, suggesting instead that a more holistic perspective is required.

The systemic nature of risks is further reinforced by the importance of coordination and interface related challenges. The involvement of multiple stakeholders, including contractors, consultants and healthcare personnel, creates a fragmented project organisation. Each actor operates within its own scope of responsibility often with different objectives and priorities. As a result, the interfaces between actors become critical points where risks are likely to emerge.

The findings suggest that many issues originate not from technical failures but from breakdowns in communication and coordination. This is supported by Respondent 2, who noted that “many risks come from misunderstandings between different actors rather than from technical issues.” This highlights the role of organisational factors in shaping risk outcomes. From a theoretical perspective, this can be linked to the concept of organisational complexity, where increased differentiation between actors leads to greater coordination challenges (Flyvbjerg, 2014). In such environments, effective communication becomes a key mechanism for reducing uncertainty and aligning activities.

The fact that misunderstandings are identified as a major source of risk also indicates that risk management cannot be limited to technical assessments. Instead, it must also address how information is shared, interpreted and acted upon within the project organisation. This shifts the focus from purely technical risk management towards a broader understanding that includes governance structures, communication processes and collaborative practices which is also highlighted in organisational risk management literature (Aven, 2016).

Operational risks related to ongoing healthcare activities represent another critical dimension that distinguishes healthcare construction from other types of projects. These risks are directly linked to the need to maintain patient safety and ensure the continuity of healthcare services. As a result, construction activities must be carefully coordinated with operational requirements which significantly constrains how work can be planned and executed.

From an analytical perspective, this introduces an additional layer of complexity as risks are not only evaluated based on their impact on project objectives such as cost and time but also on their potential consequences for healthcare delivery. The findings therefore support the view that healthcare construction projects operate within a more complex risk environment, where project risks and operational risks are tightly

interconnected. This is also reflected in national guidelines emphasising continuity and safety in healthcare construction environments (SKR, 2019; MSB, 2018).

Scheduling constraints further intensify this complexity. The requirement to perform construction activities within limited time windows reduces flexibility and increases pressure on project teams. This constraint not only affects productivity but also influences how risks are managed. Under time pressure, there is a tendency to prioritise immediate progress over thorough risk assessment which can lead to a more reactive approach.

This is clearly illustrated by Respondent 3, who explained that "we often have limited time windows, which makes it difficult to plan everything and increases the pressure during execution." This observation is consistent with research showing that time pressure is a key driver of reactive decision making in construction projects (Hillson, 2017).

Organisational risks related to governance structures and unclear responsibilities further contribute to the complexity of the risk environment. The findings indicate that responsibility for risks is not always clearly defined, particularly in projects involving multiple organisations. This lack of clarity can lead to situations where risks are not actively managed as no single actor takes ownership.

From a theoretical perspective, this reflects challenges in risk governance, where the distribution of responsibilities influences how risks are addressed (Arena et al., 2010). Effective risk management requires not only the identification of risks but also clear accountability for their management. Without this, even well identified risks may remain unmanaged in practice.

Another important aspect is the variation in risk perception among different stakeholders. Actors with different roles and responsibilities may prioritise risks differently, depending on their specific objectives. For example, contractors may focus on production related risks while healthcare staff emphasise operational and safety concerns. These differing perspectives can create challenges in aligning priorities and agreeing on appropriate mitigation measures.

Overall, the analysis demonstrates that risk types in healthcare construction projects cannot be understood in isolation. Technical, coordination, operational, scheduling and organisational risks are interconnected and mutually influencing. The complexity arises not only from the number of risks but from the relationships between them.

6.3 Analysis of Challenges Affecting Risk Management Effectiveness

The findings identify several key challenges that limit the effectiveness of risk management in healthcare construction projects including the gap between planning and execution, reactive behaviour, time pressure, project complexity, coordination issues, unclear responsibilities and organisational culture. These challenges are not independent but interrelated, forming a structural pattern that influences how risk management is performed in practice.

One of the most significant challenges is the gap between planning and execution. While risks are systematically identified and documented during early project phases, their management during construction is less consistent. This confirms the argument in the literature that risk management often struggles to transition from theoretical frameworks into practical application (Gajewska, 2011).

The empirical findings illustrate that risk registers and mitigation strategies developed during planning are not always actively used or updated during execution. As Respondent 6 described, *"there is often a difference between what is planned and what is actually implemented on site."* This highlights a disconnect between formal risk management processes and operational practices.

This gap can be explained by the lack of integration between project phases. Project based risk management theory emphasises that risk management should be continuous and iterative, adapting to changing conditions throughout the project lifecycle (PMI, 2021). However, the findings indicate that risk management is instead fragmented, with limited follow up and insufficient updating of previously identified risks. This fragmentation reduces the ability to maintain a consistent understanding of risks and undermines the proactive intent of early assessments.

The reactive nature of risk management represents another critical challenge. Despite the presence of structured processes in the early phases, the execution phase is characterised by a focus on solving problems as they arise rather than preventing them. This shift from proactive to reactive behaviour is a recurring pattern in the findings and is also widely recognised in construction management research (Hillson, 2017).

Time pressure is a key factor driving this behaviour. Healthcare construction projects are often subject to strict scheduling constraints due to the need to coordinate with ongoing healthcare operations. These constraints limit the time available for detailed analysis and planning, forcing project teams to prioritise immediate action. As Respondent 3 explained, *"you often have to act quickly, which means you solve problems instead of preventing them."*

From a theoretical perspective, this behaviour can be linked to decision making under uncertainty. When time and resources are limited, decision makers tend to rely on simplified strategies and short term solutions rather than structured analysis (Aven, 2016). While this approach allows for rapid responses, it reduces the effectiveness of risk management by limiting the ability to anticipate and mitigate risks in advance.

The inherent complexity of healthcare construction projects further reinforces these challenges. These projects involve highly interdependent technical systems, multiple stakeholders and ongoing healthcare operations, creating a high level of uncertainty. As a result, it is difficult to fully anticipate risks during the planning phase, even when structured methods are applied.

This complexity aligns with the concept of systemic risk, where risks emerge from interactions between different components rather than from isolated factors. In such environments, risk management becomes more challenging because it requires continuous adaptation and coordination rather than static planning. The findings

suggest that current practices are not fully adapted to this level of complexity which contributes to the observed challenges.

Coordination challenges further highlight the importance of communication in risk management. The involvement of multiple stakeholders creates a fragmented organisational structure, where information must be shared across different actors with varying roles and perspectives. The findings show that many risks arise at these interfaces, often due to misunderstandings or lack of information sharing.

As noted by Respondent 2, *"many risks come from misunderstandings between different actors rather than from technical issues."* This observation supports the theoretical argument that communication and collaboration are critical for effective risk management in complex projects (Chapman & Ward, 2011).

Unclear responsibilities represent another significant challenge. The findings indicate that risk ownership is not always clearly defined, particularly in projects involving multiple organisations and contractual relationships. When it is unclear who is responsible for managing a specific risk, actions may be delayed or not taken at all.

This issue reflects a weakness in organisational risk governance. According to organisational risk management theory, clear roles and responsibilities are essential for ensuring accountability and effective decision making (Arena et al., 2010). Without clear ownership, risk management becomes less effective as identified risks are not systematically followed up or managed.

Organisational culture also plays a critical role in shaping risk management practices. The findings suggest that a lack of openness and communication can delay the identification and reporting of risks. In environments where individuals are hesitant to raise concerns or share information, risks may remain hidden until they become critical.

This is highlighted by Respondent 2, who stated that *"if people do not speak up, risks are discovered too late."* This finding aligns with the concept of risk culture, which emphasises the importance of shared values, behaviours and attitudes in influencing how risks are managed within an organisation (ISO, 2018).

A weak risk culture can result in risk management being treated as a formal requirement rather than an active process. In contrast, a strong risk culture supports early identification of uncertainties, open communication, and continuous improvement. The findings indicate that cultural factors therefore play a significant role in determining the effectiveness of risk management practices.

Overall, the analysis shows that the challenges affecting risk management effectiveness are deeply interconnected. Structural issues such as fragmented processes and unclear responsibilities interact with behavioural factors such as reactive decision making and communication practices. At the same time, the complexity of healthcare construction projects amplifies these challenges by increasing uncertainty and coordination requirements.

6.4 Analysis of Conditions for Proactive Risk Management

The findings identify several critical conditions required to improve risk management practices and enable a more proactive approach in healthcare construction projects. These conditions include continuous risk management processes, early stakeholder involvement, integration between project phases, clear responsibilities, effective communication, organisational learning and the use of digital tools. Together, these elements reflect both organisational and project level requirements and align closely with recent research on risk management in complex construction environments.

From a theoretical perspective, these conditions correspond well with the principles outlined in both organisational and project based risk management frameworks. However, the empirical findings demonstrate that although these principles are recognised, they are not fully implemented in practice. This gap between theory and practice is also highlighted in recent studies which emphasise that risk management effectiveness depends not only on the existence of frameworks but on their integration into daily project activities (Taroun & Yang, 2022; Li et al., 2022).

One of the most significant conditions identified is the need for continuous risk management throughout the project lifecycle. The findings show that current practices are heavily concentrated in the early project phases, particularly during planning and design while risk management during execution becomes less structured. This creates a discontinuity that reduces the effectiveness of risk management and limits its ability to support proactive decision making.

Respondent 1 clearly emphasised this issue, stating that *"risk management should not stop after the planning phase, it needs to continue during the whole project."* This reflects the theoretical understanding that risk management must be an iterative and dynamic process, continuously updated as new information becomes available (PMI, 2021; Taroun & Yang, 2022). Without continuous monitoring and follow up, risks identified early may become outdated or irrelevant while new risks remain unmanaged.

Another key condition is the early involvement of stakeholders. The findings indicate that risk identification becomes significantly more comprehensive when a broader range of actors is involved from the beginning of the project. This includes not only project managers and consultants but also site personnel and healthcare representatives.

This supports recent research emphasising the importance of collaborative risk management, where different perspectives contribute to a more complete understanding of uncertainties (El-Sayegh et al., 2021). In healthcare construction projects, this is particularly important due to the interaction between technical systems and operational requirements. Early involvement enables the identification of risks that may not be visible in formal documentation but are critical in practice.

Furthermore, improved integration between project phases is identified as a necessary condition for proactive risk management. The findings show that there is often a disconnect between design, planning and execution phases, leading to a loss of risk related information and reduced continuity. Risks identified during early stages are

not always effectively communicated or managed during construction which contributes to the gap between planning and implementation.

This issue is consistent with findings in the literature where ineffective knowledge transfer between project phases is identified as a key barrier to risk management effectiveness (Marle & Gidel, 2021). Strengthening the integration between phases through structured handovers, continuous documentation and improved communication would therefore enhance the ability to maintain a proactive approach throughout the project lifecycle.

Clear responsibilities and accountability are also identified as critical enablers. The findings demonstrate that unclear risk ownership is a recurring issue that limits the effectiveness of risk management. When it is not clearly defined who is responsible for managing specific risks, actions may be delayed or overlooked entirely.

As Respondent 5 stated, *"when responsibilities are clear, it is much easier to manage risks."* This observation aligns with organisational risk management theory, which emphasises the importance of governance structures and accountability in ensuring effective risk management (Klakegg et al., 2021; Marle & Gidel, 2021). Clear allocation of responsibilities ensures that risks are actively managed and followed up reducing the likelihood of gaps in risk handling.

Communication and collaboration are also central conditions for enabling proactive risk management. The findings indicate that effective communication supports coordination, reduces misunderstandings and enables early identification of risks. In complex projects involving multiple stakeholders, communication becomes a critical mechanism for sharing information and aligning perspectives.

This is strongly supported by recent research, which highlights communication as a key success factor in managing risks in complex construction projects (El-Sayegh et al., 2021). The empirical findings reinforce this perspective by showing that many risks originate from communication failures rather than technical issues. Therefore, improving communication structures and promoting open dialogue are essential for strengthening risk management practices.

Organisational learning represents another important condition for improvement. The findings show that lessons learned from previous projects are not always systematically captured or applied in future projects. This limits the ability of organisations to improve risk management practices over time and leads to repeated mistakes.

From a theoretical perspective, continuous learning is a fundamental component of effective risk management systems (Taroun & Yang, 2022). By systematically capturing and integrating lessons learned, organisations can enhance their ability to anticipate risks and develop more effective mitigation strategies. The lack of structured learning processes identified in the findings therefore represents a missed opportunity for improvement.

Finally, digital tools are identified as potential enablers for proactive risk management. Tools that support real-time tracking, documentation and communication of risks can improve transparency and provide better decision

support. However, the findings indicate that the effectiveness of digital tools depends on their integration into daily workflows.

If digital tools are perceived as separate systems or administrative burdens, they are unlikely to be used consistently. This highlights the importance of usability and practical relevance in the implementation of technological solutions. Recent research confirms that digitalisation can support risk management but only when tools are aligned with user needs and organisational processes (Li et al., 2022).

Overall, the analysis demonstrates that enabling proactive risk management requires both structural and cultural changes. It is not sufficient to introduce new tools or frameworks; organisations must also ensure that risk management is embedded in daily practices supported by clear governance structures, and reinforced by a culture of communication and learning.

7 Discussion

The findings of this study show that risk management in healthcare construction projects is both structured and well established in the early phases but becomes less consistent and more reactive during the execution phase. This pattern became very clear when analysing both the literature and the interviews and it reflects a gap that is also discussed in more recent research on construction risk management (El-Sayegh et al., 2021; Li et al., 2022). From a theoretical perspective, frameworks such as ISO 31000 and PMBOK describe risk management as a continuous and integrated process throughout the entire project lifecycle but the results in this study indicate that, in practice, it is often treated as something that mainly happens in the beginning (PMI, 2021; Taroun & Yang, 2022). This creates a break in the process where risks are identified early but not always actively managed later.

This gap between planning and execution was also clearly described by the respondents. As Respondent 6 explained, "there is often a difference between what is planned and what is actually implemented on site," which highlights how formal processes are not always translated into practice. It becomes clear that the issue is not necessarily the absence of risk management tools but rather how they are used. Risk registers and workshops are actively used in early phases but their role decreases during execution and they often become static documents rather than active decision support tools. This is also supported by previous research, which argues that risk management tools lose their effectiveness when they are not integrated into daily decision making (Li et al., 2022; Marle & Gidel, 2021).

Instead, decision making during construction is largely based on experience and informal communication. Several respondents described how they rely on their own judgement to manage risks on site which reflects the need for flexibility in complex project environments. At the same time, this creates inconsistency as risk management becomes dependent on individual competence rather than structured processes. This is particularly visible under time pressure where project teams prioritise solving immediate problems instead of preventing them. As Respondent 3 described, "you often have to act quickly which means you solve problems instead of preventing them." This behaviour can be understood in relation to decision making under uncertainty where limited time leads to short term solutions rather than structured analysis (Aven, 2016; Taroun & Yang, 2022).

Another important insight from the study is that risks in healthcare construction projects are not only technical but also strongly influenced by organisational and operational factors. While technical systems such as ventilation, electricity and medical gases are critical the findings show that risks often arise from how these systems interact rather than from the systems themselves. As Respondent 4 explained, "the biggest risks are not the systems themselves, but how they affect each other when changes are made." This supports the idea of socio technical systems where risks emerge from the interaction between technical and organisational components (Love et al., 2021).

In addition, many risks are related to coordination and communication between stakeholders. The involvement of multiple actors creates a fragmented environment where misunderstandings can easily occur. This was clearly highlighted by

Respondent 2, who stated that “many risks come from misunderstandings between different actors rather than from technical issues.” This finding is strongly supported by the literature which identifies communication and coordination as critical factors in managing risks in complex construction projects (El-Sayegh et al., 2021). It also shows that risk management is not only a technical process but also a social one where communication plays a central role.

Healthcare construction projects also introduce a unique level of complexity due to the need to maintain ongoing operations. Unlike traditional construction projects these projects must ensure that healthcare services continue without disruption. This creates additional constraints related to safety, noise, access, system reliability and increases the consequences of potential failures. Previous research highlights that maintaining operational continuity is a key challenge in healthcare environments (World Health Organization, 2020; Love et al., 2021) and this was also clearly reflected in the interviews. Risks in these projects are therefore not only related to cost and time but also to patient safety and healthcare delivery.

The findings also highlight several challenges that affect the effectiveness of risk management. One of the most significant is the gap between planning and execution where risks identified early are not consistently followed up during construction. This confirms findings in recent research showing that risk management processes are often fragmented and not fully integrated into project workflows (Li et al., 2022). Another important challenge is the reactive nature of risk management, which is strongly influenced by time pressure and operational constraints.

Organisational factors also play a key role. The study shows that unclear responsibilities can lead to situations where risks are not actively managed. As Respondent 5 noted, “when responsibilities are clear, it is much easier to manage risks,” which highlights the importance of accountability. This aligns with organisational risk management theory which emphasises the role of governance structures in ensuring effective risk management (Klakegg et al., 2021; Marle & Gidel, 2021).

At the same time, organisational culture influences how risks are identified and communicated. The findings suggest that if people do not feel comfortable speaking up, risks may be identified too late. As Respondent 2 explained, “if people do not speak up, risks are discovered too late.” This supports the concept of risk culture where shared values and behaviours influence how risk management is carried out in practice (Taroun & Yang, 2022).

Despite these challenges, the study also identifies several conditions that could improve risk management and support a more proactive approach. One of the most important is the need for continuous risk management throughout the project lifecycle. The findings show that current practices are too focused on early phases which reduces their effectiveness. As Respondent 1 emphasised, “risk management should not stop after the planning phase, it needs to continue during the whole project.” This reflects the theoretical view that risk management should be iterative and continuously updated (PMI, 2021; Taroun & Yang, 2022).

Another important condition is the early involvement of stakeholders. The findings show that involving a broader range of actors improves risk identification by

incorporating different perspectives. This aligns with recent research on collaborative risk management which emphasises the value of combining technical and practical knowledge (Li et al., 2022).

Improving integration between project phases is also essential. The results indicate that there is often a lack of communication and knowledge transfer between design, planning and execution which contributes to the gap identified earlier. Strengthening this integration could improve continuity and make risk management more effective throughout the project.

Clear responsibilities, effective communication and organisational learning are also identified as key factors. The study shows that lessons learned are not always systematically applied which limits improvement over time. Digital tools are mentioned as potential enablers but their effectiveness depends on how well they are integrated into daily work processes.

Overall, this study shows that improving risk management in healthcare construction projects requires more than new tools or frameworks. It requires a shift towards a more continuous, integrated and collaborative approach where risk management is embedded in daily activities rather than treated as a separate task. The findings also highlight that risk management is not only a technical issue but also a human and organisational one, shaped by communication, culture and decision making. This understanding is important for developing more effective and proactive risk management practices in complex construction environments.

8 Conclusion

The purpose of this study was to analyse how risk management is currently conducted in healthcare construction projects and to understand how a more proactive approach can be developed. After working with both literature and interviews, it became clear that healthcare construction projects are much more complex than ordinary construction projects. These projects are carried out in environments where hospitals and healthcare facilities must continue operating during construction which means that even small disturbances can create serious consequences for patients, staff and daily operations.

One of the main conclusions from this study is that risk management already exists as an important part of healthcare construction projects but that it is not always used in a continuous and practical way throughout the whole project process. During the planning and design phases, projects often work with structured methods such as risk workshops, meetings and risk registers. At this stage, risks are discussed in a systematic way and many stakeholders are involved. However, when the project moves into the execution phase, the work becomes more reactive and based on experience instead of structured follow up.

The interviews clearly showed that many project teams focus on solving problems when they appear instead of preventing them earlier. This does not mean that people ignore risks but rather that the reality on site becomes very dynamic and difficult to fully control. Time pressure, changing conditions and coordination problems force project teams to make quick decisions. Because of this, risk management often becomes part of daily operational problem solving instead of a proactive process that guides the project continuously.

Another important conclusion is that risks in healthcare construction projects are strongly connected to each other. Technical systems, communication, organisational structures and ongoing healthcare operations all affect one another. The study showed that many problems are not caused by one single technical failure but by misunderstandings, lack of coordination or unclear responsibilities between actors. This means that risk management in healthcare projects is not only about technical solutions. It is also about communication, collaboration and organisational culture.

The findings also show that experience plays a very important role in managing risks. Many respondents explained that experienced project managers, construction managers and site personnel are often able to identify risks early because they recognise patterns from previous projects. At the same time, this creates differences between projects depending on the competence and experience of the people involved. A more structured and continuous system could therefore help organisations become less dependent on individual experience alone.

Another reflection from the study is that healthcare construction projects require much stronger collaboration between construction organisations and healthcare operations. In many cases, healthcare staff have knowledge about operational risks that construction teams may not fully understand. At the same time, construction teams understand technical and production related risks that healthcare staff may not

see. The study therefore shows that early involvement and continuous communication between different actors are necessary for improving risk management.
The study also demonstrates that organisational factors influence risk management more than expected. Governance structures, decision making processes and responsibilities affect how quickly risks are handled and how information flows between project actors. In public sector projects, formal structures are important for accountability but they may also slow down decision making during critical situations. This creates a challenge where projects must balance structure and flexibility at the same time.

Based on the findings, it can be concluded that proactive risk management in healthcare construction projects requires more than just tools and documents. Risk management needs to become a continuous process that is integrated into everyday project work. It should continue through all project phases and involve both strategic and operational perspectives. The study suggests that clearer responsibilities, improved communication, better follow up and stronger organisational learning are important conditions for improving current practices.

Personally, one of the most interesting things during this study was understanding how complex healthcare construction projects really are. Before starting the research, risk management seemed like a structured technical process but through the interviews it became clear that human factors, communication and practical experience are equally important. It also became clear that many professionals already understand the importance of proactive risk management but that practical conditions often make it difficult to work in a fully proactive way.

Even though this study focuses on a limited number of interviews and projects, the findings still provide valuable insights into how risk management works in healthcare construction environments. The study contributes with a better understanding of the challenges that exist in practice and highlights areas where improvements are needed in order to support safer and more efficient healthcare construction projects in the future.

8.1 Suggestions on Future Studies

This study has mainly focused on qualitative experiences and perspectives from professionals working in healthcare construction projects. Future studies could therefore continue exploring this topic from several different perspectives.

One possible area for future research is to test and evaluate the proactive risk management framework developed in this study in real construction projects. It would be valuable to investigate how the framework functions in practice and whether it can improve communication, coordination and early risk identification during project execution.

Another interesting direction would be to study how digital tools and technologies can support proactive risk management in healthcare construction. Several respondents mentioned that digital systems have potential but that they are not always integrated into daily project work. Future research could therefore examine how tools such as

BIM, digital risk platforms or AI based systems can support continuous risk monitoring and collaboration between stakeholders.

Future studies could also compare healthcare construction projects with other complex construction environments, such as infrastructure or industrial projects. This could help identify which challenges are specific to healthcare environments and which are common across the construction industry.

In addition, it would be valuable to investigate the perspective of healthcare staff more deeply. This study mainly focused on construction and project management professionals, but nurses, doctors and operational staff are also strongly affected by construction activities in hospitals. Their experiences could provide additional insights into operational risks and patient safety related challenges.

Finally, future research could focus more on organisational culture and leadership in relation to risk management. The findings in this study suggest that openness, communication and collaboration strongly influence how risks are managed in practice. Understanding how organisations can create stronger risk cultures could therefore be an important area for further development.

9 References

Adams, W. C. (2015). *Conducting Semi-Structured Interviews.*

Akintoye, A., & MacLeod, M. (1997). Risk analysis in construction. *International Journal of Project Management, 15*(1), 31–38.

Archibald, M. M., et al. (2019). Using Zoom Videoconferencing for Qualitative Data Collection. *International Journal of Qualitative Methods, 18.*

Arena, M., Arnaboldi, M., & Azzone, G. (2010). The organizational dynamics of enterprise risk management. *Accounting, Organizations and Society, 35*(7), 659–675.

Aven, T. (2016). Risk assessment and risk management. *European Journal of Operational Research, 253*(1), 1–13.

Braun, V., Clarke, V., Hayfield, N., & Terry, G. (2019). *Thematic Analysis.*

Castleberry, A., & Nolen, A. (2018). Thematic analysis of qualitative research data. *Currents in Pharmacy Teaching and Learning, 10*(6), 807–815.

Chapman, C., & Ward, S. (2011). *How to Manage Project Opportunity and Risk.* Wiley.

Creswell, J. W., & Creswell, J. D. (2018). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches.* Sage Publications.

DiMaggio, P., & Powell, W. (1983). The iron cage revisited. *American Sociological Review, 48*(2), 147–160.

Dikmen, I., Birgonul, M. T., & Han, S. (2007). Using fuzzy risk assessment. *Building and Environment, 42*(4), 1718–1728.

El-Sayegh, S., Manjikian, S., Ibrahim, A., Abouelyousr, A., & Jabbour, R. (2021). Risk management in construction projects: A systematic literature review. *Buildings, 11*(10), 470.

Etikan, I., & Bala, K. (2017). Sampling and sampling methods. *Biometrics & Biostatistics International Journal.*

European Commission. (2020). *Data protection and GDPR guidelines.*

Fleming, J., & Zegwaard, K. E. (2018). Methodologies, methods and ethical considerations for conducting research in work-integrated learning.

Flyvbjerg, B. (2014). What You Should Know about Megaprojects. *Project Management Journal, 45*(2), 6–19.

Gajewska, E. (2011). *Risk management practices in a construction project.* Chalmers University of Technology.

Hillson, D. (2017). *Practical Project Risk Management* (2nd ed.). Management Concepts Press.

Hopkin, P. (2018). *Fundamentals of Risk Management* (5th ed.). Kogan Page.

ISO. (2018). *ISO 31000:2018 Risk management — Guidelines.* ISO.

ISO/IEC. (2019). *IEC 31010:2019 Risk assessment techniques.* ISO.

Kerzner, H. (2022). *Project Management* (13th ed.). Wiley.

Klakegg, O. J., Williams, T., Shiferaw, A., & Andersen, B. (2021). Governance frameworks for public sector projects. *International Journal of Project Management, 39*(2), 124–137.

Kutsch, E., & Hall, M. (2010). Deliberate ignorance in project risk management. *International Journal of Project Management, 28*(3), 245–255.

Li, Y., Wang, S., & Xu, J. (2022). Risk assessment and management in construction projects: A systematic review. *Sustainability, 14*(4), 2202.

Love, P. E. D., et al. (2016). Disruption risks in healthcare construction. *Engineering, Construction and Architectural Management, 23*(3).

Love, P. E. D., Matthews, J., Simpson, I., Hill, A., & Olatunji, O. (2021). A benefits realization management building information modeling framework for asset owners. *Automation in Construction, 125*, 103558.

Love, P. E. D., et al. (2021). Managing risk and resilience in healthcare infrastructure projects.

Marle, F., & Gidel, T. (2021). *Project Risk Management.* Springer.

Martek, I., et al. (2022). Sustainable risk management in construction projects.

Marzouk, M., & Azab, S. (2020). Environmental and operational risks in hospital construction projects. *Journal of Construction Engineering and Management, 146*(7).

Meyer, J., & Rowan, B. (1977). Institutional organizations. *American Journal of Sociology, 83*(2), 340–363.

MSB. (2018). *Det robusta sjukhuset.* MSB.

Nikander, I., & Eloranta, E. (2001). Early warnings in projects. *International Journal of Project Management, 19*(7), 385–399.

Olanrewaju, A., & Babarinde, S. (2021). Managing risks in public infrastructure projects. *Journal of Engineering, Design and Technology, 19*(5), 1163–1180.

Paul, J., et al. (2021). Scientific procedures and rationales for systematic literature reviews. *International Journal of Consumer Studies.*

PMI. (2021). *A Guide to the Project Management Body of Knowledge (PMBOK Guide).* PMI.

Power, M. (2007). *Organized Uncertainty.* Oxford University Press.

Raz, T., Shenhar, A., & Dvir, D. (2002). Risk management and project success. *International Journal of Project Management, 20*(2), 101–109.

Reason, J. (1997). *Managing the Risks of Organizational Accidents.* Ashgate.

Reiling, J. (2006). Safe design of healthcare facilities. *Quality and Safety in Health Care, 15*(suppl 1), i34–i40.

Renn, O. (2008). *Risk Governance.* Earthscan.

Řeháček, P. (2017). Risk management standards for project management. *International Journal of Advances in Applied Sciences, 4*(6).

Saunders, M., Lewis, P., & Thornhill, A. (2019). *Research Methods for Business Students.* Pearson.

Serra, C., & Kunc, M. (2015). Benefits realization management. *International Journal of Project Management, 33*(1), 53–66.

SKR. (2019). *Byggarbete på sjukhusområden.* Sveriges Kommuner och Regioner.

Snyder, H. (2019). Literature review as a research methodology. *Journal of Business Research, 104*, 333–339.

Taroun, A. (2014). Towards a better modelling of risk in construction. *International Journal of Project Management, 32*(1), 101–115.

Taroun, A., & Yang, J. (2022). Risk management in construction projects: A knowledge-based approach. *International Journal of Project Management, 40*(3), 245–257.

Taroun, A., & Yang, J. (2022). Risk management in complex construction projects.

Ulrich, R. S., et al. (2008). Effects of healthcare environmental design. *HERD Journal, 1*(3), 61–125.

United Nations. (2023). *Sustainable Development Goals Report.*

Ward, S., & Chapman, C. (2003). Transforming project risk management. *International Journal of Project Management, 21*(2), 97–105.

Williams, T., et al. (2012). Identifying early warning signals. *International Journal of Project Management, 30*(2), 256–270.

World Health Organization. (2020). *Safe hospitals framework.* WHO.

Yin, R. K. (2018). *Case Study Research and Applications.* Sage Publications.

Zou, P. X. W., Zhang, G., & Wang, J. (2007). Understanding key risks in construction. *International Journal of Project Management, 25*(6), 601–614.

Appendix A – Interview Questions

1. Can you briefly describe your role and responsibilities in healthcare construction projects?

2. How long have you been involved in construction projects related to healthcare facilities?

3. What types of projects have you mainly worked on (e.g., new hospitals, renovations, technical upgrades)?

4. How is risk management typically conducted in your projects?

5. At what stages of the project lifecycle are risks usually identified and assessed?

6. What tools or methods are commonly used for identifying and documenting risks in your projects?

7. How are risks communicated and followed up during the project?

8. What are the most common risks encountered in healthcare construction projects?

9. What challenges do you experience when managing risks in projects that take place in operational healthcare environments?

10. In your experience, are risks usually managed proactively or reactively? Why?

11. How do organisational structures, regulations, or procurement processes influence how risks are managed in your projects?

12. How important is collaboration between different stakeholders (e.g., contractors, healthcare staff, consultants) in managing risks?

13. In your opinion, what role does organisational culture play in how risks are identified and addressed?

14. What methods or practices could help identify risks earlier in healthcare construction projects?

15. What improvements would you suggest for developing a more proactive risk management approach in healthcare construction projects?