Fall 2022 CE – GY 8393 Leadership, Ethics and Project Execution Final Project and Research Initiative

Project Sponsor: NYCDDC Town + Gown



Part 1:

Risk Assessment and Mitigation Strategies to Inform the Project Execution Plan





Risk Management and Project Execution

Team 10: Tun Win Abhishek Nandagon Nirmal Mody Adishri Patil

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DDC Risk Categories



Industry definition of Risk Management

Construction industry defines risk management as a process of evaluating and implementing procedures to reduce or if possible eliminate the impact of risks from all aspects of a construction project, collectively with the cooperation of all the involved stakeholders, right from the initiation phase to the completion of the project

DDC Definition of risk management- Project Controls guidelines

Risk management is a process of identifying all the potential risks (opportunity and threats) by involving all the major stakeholders including the sponsor agency, design consultant (following design start), DDC project team, DDC A&E and contractors (following construction start)



Take away from the initial data review



Design Phase



	# of
Risk Category	Occurrence
1. Scope Management	17
- 0	
2. Schedule Management	26
0	
3. Cost Management	7
4. Quality Management	20
5. Resource Management	4
6. Procurement	
Management	1
7. Stakeholder	
Management	11
8. External Environment	17
9. Construction Conditions	11



Construction Phase



Risk Category	# of Occurrence
1. Scope Management	5
2. Schedule Management	40
4. Quality Management	5
5. Resource Management	1
6. Procurement Management	2
7. Stakeholder Management	14
8. External Environment	23
9. Construction Conditions	111



Best Practices



Recommendation for DDC

- Use of survey tool as an integration technique.Opening new channels of communication for relaying information faster.
- Monthly review of the site conditions.
- Identification of gaps in current risk management strategy.
- Distribution of risk amongst all the stakeholders -(skin in the game).
- Assume/accept risks and have contingencies in place.





1. How confident your organization/subcontractors are committed to make the project successful. (What are your plans to make the project successful?)

2. How confident is your organization/subcontractors have a risk mitigation plan for the project?

3. Would you plan to track your organization/subcontractors project performance throughout the project?

4.Do you think you can improve your (your subcontractors) performance?

5.Do your organization/subcontractors has contingency plan in place if the project gets delayed?

6.Do you believe your organization/subcontractors contingency plan will work if the project gets delayed.

7. What is your expectation from stakeholders/what kind of help are you looking from stakeholders?





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Scope Management Risk Analysis

TEAM I AADISH SHAH RAJ DHANGAR TIRTH PATEL

Risk definition- Industry Vs DDC

Industry Definition

Scope refers to the detailed set of deliverables or features of a project. These deliverables are derived from a project's requirements. Project Scope as the "The work that needs to be accomplished to deliver a product, service, or result with the specified features and functions."

DDC Definition

Scope refers to the set of description of the work which needs to be fulfilled in order to deliver the public/infrastructure projects. Scope of work includes quality, design and time period for the specific project.



Research Methodology

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Overall Breakdown of DDC Data

3 MAIN RISK SUBCATEGORY AS PER NYC DDC DATA





SCOPE CHANGE ACCORDING TO CONSTRUCTION PHASES- NYC DDC DATA



Risk Factors Identified by DDC

Risk factor	Account	Percentage
Client Expectations	83	27%
Geotech Conditions	3	0.98%
Utilities	13	4%
Inadequate old plans	3	1%
Lack of Specifications	2	0.65%
Delayed by DEP	70	23%
Delayed by DOT	7	2%
Design Errors/Consultants	29	9.45%
Acquisitions	10	3.26%
Poor Estimation	9	2.93%
Delayed by FDNY	5	1.63%
SHPO	3	0.98%
Project phasing	8	2.61%
Covid	7	2.28%
Electrical issues	6	1.95%
Payment	4	1.30%
Inadequate Front-End Planning	15	4.89%
HVAC	6	1.95%
Inconsistencies in Contract Documents	22	7.17%
New Regulations	2	0.65%
TOTAL	307	100%

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Risk Factors of Scope Management



 Client Expectations 	 Geotech Conditions 	= Utilities	Inadequate old plans
 Lack of Specifications 	Delayed by DEP	 Delayed by DOT 	 Design Errors/Consultants
 Acquisitions 	 Poor Estimation 	 Delayed by FDNY 	 SHPO
 Project phasing 	Covid	Electrical issues	 Payment
Inadequate Front End Planning	= HVAC	Inconsisitencies in Contract Documents	New Regulations

Risk Identified from Industry Data

Risk Factors of Scope Management

Risk factor	Account	Percentage
Client Expectations	9	22.50%
Design Errors	6	15%
Poor Estimation	3	8%
Lack of Specification	1	3%
Inadequate Front-End Planning	1	2.50%
Value Adding Change	1	3%
New Regulations	2	5.00%
Lack of Definition	9	23%
Environmental Factors	3	7.50%
Inconsistencies in Contract Documents	2	5.00%
Transience	1	2.50%
Others	2	5.00%
TOTAL	40	100



Top 5 Risks Compared

NYC DDC Data
1. Client Expectations
2. Delayed by DEP
3. Design Errors
4. Inadequate Front-end Planning

5. Inconsistencies in contract documents

Literature Review Data
1. Client Expectations
2. Poor Estimation
3. Design Errors
4. Environmental Factors
5. Lack of definition



Risk Mitigation Best Practices

- A Responsibility Matrix
- BIM execution plan
- Two-way communication





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Schedule Management Risk Analysis

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Cost Management Risk Analysis

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Quality Management Risk Analysis

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NYU TANDON RISK MANAGEMENT AND ITS IMPACT ON PROJECT EXECUTION

TEAM 6 - QUALITY MANAGEMENT

PRESENTED BY TEAM 6 : AARSH BHATVIA PRASHANTH ANDANI ROHITH SIDDAPPA SWAMY

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KEY PERFORMANCE INDICATORS

- NUMBER OF DEFECTS DUE TO WORKMANSHIP.
- CLIENT SATISFACTION.
- TOTAL COST OF REWORK.
- EMPLOYEE SATISFACTION
- FINAL WORKS INSPECTION



QUALITY MANAGEMENT DEFINITION - INDUSTRY

Industry:

The optimization of the quality activities involved in producing a product, process or service. As such, it includes prevention and appraisal activities.





BUBBLE CHART OF LITERATURE REVIEW





RISK FACTORS FROM NYC DDC DATA

Sr.No.	Risk Factor	Amount	Percentage
1	Documentation	22	21
2	Redesign	20	19
3	Schedule delay	15	14
4	Estimate	12	11
5	Delay in review	8	8
6	Resubmission	5	5
7	Rework	4	4
8	Estimate error	4	4
9	Stop work	4	4
10	Cost	2	2
11	Safety issue	2	2
12	Traffic flow	2	2
13	Change in SOW	1	1
14	Inacurate format	1	1
15	Inspection	1	1
16	Regulations	1	1
17	Submission delay	1	1
18	Placement error	1	1
	Total	106	100

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Documentation

- Redesign
- Schedule delay
- Estimate
- Delay in review
- Resubmission
- Rework
- Estimate error
- Stop work
- Cost
- Safety issue
- Traffic flow
- Change in SOW
- Inacurate format
- Inspection
- Regulations
- Submission delay
- Placement error

RISK FACTORS FROM THE LITERATURE REVIEW

Sr.No.	Risk Factor	Amount	Percentage	
1	Contractor's poor management	25	21	Literature Review Data
2	Design errors and inaccuracy	21	18	Contractor's poor
3	Unqualified Consultant group	16	13	5%1% Contractor's poor management
4	Improper maintenance of equipment and material handling	15	13	^{0%} 21% ■ Design errors and
5	Unskilled Labors and lack of labor supervision	12	10	10% inaccuracy
6	External weather condition and external factors	12	10	Unqualified Consultant group
7	Lack of Owner's involvement	11	9	10% 18%
8	Project group inefficient decision making	6	5	Improper maintenance of
9	Construction supply Chain	1	1	13% equipment and material handling
	Total	119	100	



TOP 5 RISKS FROM NYC DDC & LITERATURE REVIEW

NYC DDC Risk Factors	Literature Review Risk Factors
Documentation	Contractor's poor management
Redesign	Design errors and inaccuracy
Schedule delay	Unqualified Consultant group
Estimate	Improper maintenance of equipment and material handling
Delay in review	Unskilled Labours and lack of labour supervision



RISK MITIGATION BEST PRACTICES

- Review the challenges and success of each project and proactively and effectively use the feedback of future projects.
- <u>Kick-off</u> meetings should be held with all subcontractors.
- Constructability and maintainability reviews should be scheduled and resourced in advance.
- <u>Supplier equipment</u> should be checked to ensure compliance with purchase specifications.
- Work collaboratively with consultants and contractors where necessary and harness their experience.





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Resource Management Risk Analysis

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Resource Management Risk Analysis



Risk Definition - Industry Vs DDC

Industry Definitions

A resource risk is the chance that you will fail to meet a goal due to a lack of resources. Resources can include financing, time, skilled workers and anything else you need to achieve a particular goal.

DDC Definition

Resources can Include shortage of staff, attrition, hiring challenges, and current staff skills and qualifications. Events related to existing or lack of policies, standard procedures and templates, etc. Potentials and challenges of new technology, lack of training, delays in obtaining licenses, as well as other technology related events.



What are general construction resources

- Labor
- Material
- Equipment
- Finance
- Time



Resources organized by Stakeholders

Owners/Clients

- Finance
- Managerial staff
- Facilities
- Organizational structure
- Technology
- Training

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Contractor

- Construction
 Labor
- Material
- Equipment
- Technology
- Training

Consultants

- Skilled labor
- Technology
- Training
Risk Factors identified by DDC

Risk factor	Account	Percentage
Labour Shortage	5	29.41%
Design change and addition	3	17.65%
Delayed orders	2	11.76%
Unclear objectives and additional resources	1	5.88%
Additional skilled staffing	1	5.88%
Improper management decisions	1	5.88%
Change orders	1	5.88%
Lack of manpower accessibility	1	5.88%
Reduced/lack of technical expertise	1	5.88%
Material/ equipment Lead time	1	5.88%
Total	17	

Risk Factors of Resource Management



- Labour Shortage
- Delayed orders
- Additional skilled staffing
- Change orders
- Reduced/lack of technical expertise

- Design change and addition
- Unclear objectives and additional resources
- Improper management decisions
- Lack of manpower accessibility
- Material/ equipment Lead time

Risk's Identified from Industry data

<u>12 research papers/books ranging from 1984 to 2022</u>



Risk factor	Account	Percentage
Resource and source availabiliy	12	11.7%
Damaged resource/potential damage of resource and Quality	12	11.7%
Improper management decisions and reviews	11	10.7%
Lack of manpower accescibility/ Less prodctivity	9	8.7%
Unclear objectivee, additional resources and allocation	8	7.8%
material/ equipement Lead time	8	7.8%
Additional skilled staffing and skills	7	6.8%
Labour Shortage and labour strikes	5	4.9%
reduced/lack of technical expertise	5	4.9%
New Technologies and utilization	5	4.9%
Poor Maintenance of resource	5	4.9%
Design change, addition and approvals	4	3.9%
Material and labour mobilization time	4	3.9%
Change orders	3	2.9%
Financing issues	2	1.9%
Delayed orders/ Improper orders	1	1.0%
Resource downtime	1	1.0%
Additional workload	1	1.0%
Total	103	

Risk Factors identified by Industry data



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Top 5 Risks

	Top 5 Risk factor			
No, DDC Data		Industry Data		
1 Labour Shortage Resource and source availabiliy		Resource and source availabiliy		
2	Design change and addition	Damaged resource/potential damage of resource and Quality		
3	Delayed orders	Improper management decisions and reviews		
4	Unclear objectives and additional resources	Lack of manpower accescibility/ Less prodctivity		
5	Additional skilled staffing	Unclear objectivee, additional resources and allocation		





Bubble Chart of DDC identified risks





KPI's Identified (DDC Data and Research)

- Labor Downtime
- Labor Productivity
- Employee
 Satisfaction/reviews
- Employee Retention/turnover
- Training metrics
- Industry standard technology
- Compliance with contractors
- Procedure for Introduction of softwares
- Al compliance and usage

- Equipment Downtime
- Maintenance metrics
- Wastage per job/day
- Productivity per day/job
- Availability in market
- Supply Chain Management
- Inventory management
- Retention/turnover
- Satisfaction/reviews
- Productivity
- Non-compliance issues/complaints
- Emergency contacts

KPI's Categorized by Stakeholder Responsibility

- Employee Satisfaction/reviews Project Employee Retention/turnover Owner in senior management (DDC)
 - Lack of Project management software
 - Increased technical advances (incompetency to new inventions)
 - AI compliance and usage
- Project **Consultants**

Project GC

- High costs of softwares (cost benefit analysis)
- Low utilization of softwares and tools
- Procedure for Introduction of softwares
- Labor Downtime
- Labor Productivity
- Supply Chain Management
- Inventory management **NYU TANDQN**
 - Maintenance metrics
 - Wastage per job/day
 - Productivity per day/job

- **Training metrics**
- Maintenance metrics
- Lack of Technical awareness

- Unavailability of skilled professionals ۲
- Lack of tech managers and tech management
- Training metrics
- Industry standard technology

- High cost of new technology
- Accessibility and availability
- Lack of Tech knowledge •
- Lack of Maintenance, management and ٠ utilization knowledge
- Availability in market .

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Risk Mitigation-Best Practices

- Monitoring **potential damage/quality issues** along with resource shortages could be advantageous
- Monitoring **PM integration** and **information flow** challenges as part of resources would impact overall use of resources
- **Retention, turnover and down times** for labor and equipment are important performance metrics
- **Training** integration and its metrics need to be added
- Management and the managerial process should be considered a resource and monitored





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Procurement Management Risk Analysis

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Stakeholder Management Risk Analysis

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Stakeholder Management

Shan Jiang, Rui Xiao, Prof. Frank X. DarConte

Research Methodology





Stakeholder Management

Risk Definition – DDC vs Industry

• Industry Definition

Stakeholder Management includes any risks that can affected stakeholder and affect by the stakeholder. Risk management associated with each stakeholder should be identified and categorized, and requires coordination and management among stakeholders DDC Definition

The management of stakeholders includes events caused by improper coordination and communication, claims and disputes between stakeholders, as well as sponsorship and government regulation-related events, events involving surrounding communities and public, impacts from projects within the program or from external projects impacting the project, and other stakeholder-related risk.



Top 5 Risks of Stakeholder Management - DDC vs Industry

DDC Risks	Number	Industry Risks
Approval	1	Demand Issue
Department Issue	2	On site Issue
Permission	3	Design
Sponsor Issue	4	Logistics and delivery
Project Interface Issue	5	Communication/Conditio n



Stakeholder Management

NYC DDC Identified Risk

DDC Identified Risks	Count	Percentage
Approval	15	17.44%
Department Issue	15	17.44%
Permission	9	10.47%
Sponsor Issue	8	9.30%
Project Interface Issue	8	9.30%
Negoication Between parties	7	8.14%
Project oversight	6	6.98%
Communication Issue	5	5.81%
Community Issue	4	4.65%
Safety and Environment Issue	3	3.49%
Client/Owner Issue	2	2.33%
Litigation	2	2.33%
Change Order	2	2.33%
Sum	86	





Overall Schedule Impact (DDC Data)





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Literature Review Identified

ľ	DDC Identified Risks	Count	Percentage
	Demand Issue	21	13.04%
	On site Issue	20	12.42%
	Design Issue	16	9.94%
	Logistics and delivery	14	8.70%
	Coordination	12	7.45%
	Litigation	12	7.45%
	Documents/File	11	6.83%
	Payment and Cost	9	5.59%
	Regulation and policy	7	4.35%
	Quality Control	7	4.35%
	Environmental Influence	6	3.73%
	Safety	6	3.73%
	Supplier related Risks	5	3.11%
	Schedule and planning	5	3.11%
	Others	4	2.48%
	Main contractors related	3	1.86%
	Sub-contractors related	3	1.86%
	Sum	161	

Literature Review Identified Main Risk Factor

















Bubble Chart Combin ed

Stakeholder Management Key Performance Indicators

Communication

- Communication effectiveness
- Timeliness of response from external stakeholders
- Active and honest information exchange between all stakeholders
- Level of coordination between stakeholders
- Information Transparency in Communication

Stakeholder Impact

- Level of influence stakeholders have on decisionmaking
- Impact of stakeholder involvement on the project's performance
- Stakeholder's influence on project schedule, cost, quality, or safety
- Effective management and consultation of stakeholder needs
- Quick resolution for change orders (client, the contractor, or the designer)
- Effective deterrence and resolution of defaults
- Effectively resolve approval, permit, license issues

Stakeholder Relationship

- Alignment of stakeholders to work on mutual project goals
- Effectively resolve conflicts of requirements of interest stakeholders
- Management of project interface issues
- Clear understanding of the relationship between each stakeholder and project
- Level of stakeholder engagement
- Level of stakeholder cooperation
- Level of trust

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Stakeholder Management

Risk Mitigation – Best Practices

- Communication &
 Coordination are key links
- By regularly engaging and keeping them informed of the project
- Dedicated team member/Third party responsible

- Building strong relationships & Working collaboratively
- Develop contingency plans (including identifying alternative suppliers or contractors, or developing backup plans in case of delays or other problems).
- Stakeholder-risk Management



Stakeholder Management



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External Environment Risk Analysis

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External Environments and Relation to Risk

A Path to Achieving Highly Successful Project Outcomes

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External Environment Risk Definition - Industry vs DDC

DDC Definition

In the past, the DDC has described the risk as external environments mainly related to issues such as COVID and the economy. Literature Review Definition

External Environments include factors that can impact project execution either positively or negatively, leading to the overall success or failure of a project. These include weather, governments, etc.







Literature Review vs DDC Data

Rank	Risk factor	Description
1	Client driven change orders	Changes from the owner once the project has begun
2	Holidays	Holidays outside of the normal federal holidays
3	Community relations	Community feedback of the project
4	Changes involving internal affairs at the GC or trades	Conflicts involving contractor or subs
5	Outside consulting firms	Consultants hired by any stakeholder

Rank	Risk factor	Description
1	Force Majeure (Greater Force)	Forces outside our control
2	Economy	Economical issues
3	Public Health Emergency	Events due to pandemics, epidemics, outbreaks of infectious diseases or any other public health emergency.(Covid 19).
4	Market Conditions	impacts of the current status of the construction market conditions and economic conditions
5	Natural Hazards	Impacts of unforeseen natural hazards, such as severe climatic conditions, storms, floods, droughts,etc



Best practice for mitigation

1. Client Driven Change Orders

- Have a clear understanding of what the client wants.
- Keep them involved throughout the process, and have progress meetings to go over the next phases, see if there are any additions they might like to add. This way you can stay ahead of any changes and can plan for them.

2. Holidays

- Lay out all of the holidays that will be taking place during your project's duration on a scheduled colander.
- Keep notes of what deadlines you need to meet, the material needed and their lead times. Order the material ahead of time so the holidays don't delay you.

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3. Community Relations •Develop a strong relationship with community leaders •Keep an open line of communication and be responsive •Maintain a clean and attractive job site

4. Changes involving internal affairs at the GC or trades

• Establish relationship with all parties before job begins. Host a precon meeting with all parties.

5. Outside Consulting Firms

 Closely monitor the relationship with outside consulting firm and fully understand their interest and place in the project





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Construction Condition Risk Analysis

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Construction Concitions

Hongii Lin, Lingrui Xu, Juan Guerrero



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Introduction

Construction Conditions

Risk Definition – DDC vs Industry

- Construction Condition risks include environmental conditions, private utilities, subsurface field conditions, above-grade field conditions, health and safety, site access and ownership, surrounding structures, site layout, testing and commissioning, and lastly, other events related to construction conditions.
- Construction Condition risk can simply be defined as certain loss exposure encountered throughout the course of a construction project. Construction Condition risk can present itself through events related to natural disasters, poor weather conditions, unanticipated hazards on-site, events related to unanticipated non-environmental subsurface conditions discovered during excavation, events related to the health and safety of construction workers, events related to the shortage of skilled labor, resources, materials, and equipment, and lastly, events associated with testing and commissioning
Top 5 Risks of Construction Conditions - DDC vs Industry

Number (#)	DDC TOP 5 RISKS	RISK DESCRIPTIONS	INDUSTRY TOP 5 RISKS	RISK DESCRIPTIONS
1	Private Utilities	Events related to utility providers (such as Con Ed, National Grid, Verizon, Spectrum, ECS, etc.), e.g., unmapped utility interference, delays in utility relocation, etc.	Environmental Conditions	Events related to natural disasters (such as wildfires, earthquakes, hurricanes, flooding, storms, tornadoes, etc.), poor weather conditions, and unanticipated hazards on-site (such as harmful gas, hazardous soil, asbestos, etc.)
2	Subsurface Field Conditions	Events related to unanticipated non- environmental subsurface conditions discovered during excavation, such as hard rock, boulders, low bearing-capacity soil, archeological findings, vaults, high water table, etc.	Subsurface Field Conditions	Events related to unanticipated non-environmental subsurface conditions discovered during excavation, such as hard rock, boulders, low bearing-capacity soil, archeological findings, vaults, high water table, etc.
3	Above-Grade Field Condition	Events related to unanticipated non- environmental above-grade field conditions discovered during construction, such as existing slab construction unstable for support of new material, missing neutral in the electrical panel, etc.	Health & Safety	Events related to the health and safety of construction workers and the public as a result of construction activities.
4	Environmental Conditions	Events related to unanticipated HAZMAT discovered on existing sites, such as hazardous soil, asbestos or lead discovered, buried tank, etc.	Skilled Labor, Resources, Materials, & Equipment Shortages	Events related to the shortage of skilled labor, resources (such as Estimator, Architect, Supervisor, Engineer, Construction Worker, etc.), materials (such as brick, steel, stone, wood, etc.), and equipment (such as bulldozers, excavators, cranes, etc.)
5	Site Access and Ownership	Events related to site accessibility and ownership, which can include unforeseen inaccessibility or restricted access, delayed site acquisition, easement or ownership issues, etc.	Testing & Commissioning	Events associated with testing and commissioning

Analysis of NYC DDC Risk Data



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Risk Types – Level of Occurrence



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Schedule Impact

Subcategories	#	Total Delay Days	Avrage Delay (per Case, Abs)	Delay Median (Abs)	Max(Abs)	Min(Abs)	# > mean(CC)	# > Median(CC)	% > mean(CC)	% > Median(CC)	# > mean(Overall)	# > Median(Overall)	% > mean(Overall)	% > Median(Overall)
9.01 Environmental Conditions	48	5921	123	33	977	1	14	24	29.2%	50.0%	9	17	18.8%	35.4%
9.02 Private Utilities	575	50801	88	24	1232	1	125	247	21.7%	43.0%	84	152	14.6%	26.4%
9.03 Subsurface Field Conditions	139	15914	114	41	1262	1	41	77	29.5%	55.4%	30	45	21.6%	32.4%
9.04 Above Grade Field Condition	57	9163	161	88	952	1	23	43	40.4%	75.4%	15	29	26.3%	50.9%
9.05 Health and Safety	27	1672	62	12	563	1	4	8	14.8%	29.6%	3	4	11.1%	14.8%
9.06 Site Access & Ownership	35	4090	117	37	1140	1	9	19	25.7%	54.3%	7	9	20.0%	25.7%
9.07 Surrounding Structures	24	2972	124	22	959	1	7	10	29.2%	41.7%	5	7	20.8%	29.2%
9.08 Site Layout	6	788	131	132	266	33	3	5	50.0%	83.3%	1	4	16.7%	66.7%
9.09 Testing & Commissioning	13	1358	104	60	271	2	5	11	38.5%	84.6%	3	5	23.1%	38.5%
9.99 Other	185	26049	141	53	2484	1	65	108	35.1%	58.4%	37	71	20.0%	38.4%

Analysis about Overall Schedule Impact (CCDs) [Abs.]



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	#	Total Delay Days	Avrage Delay (per Case, Abs)	Delay Median (Abs)	Max(Abs)	Min(Abs)
1 Scope Management	306	123645	404	181	5685	1
2 Schedule Management	280	45796	164	63	4763	1
3 Cost Management	116	36348	313	150	6188	8
4 Quality Management	81	10748	133	66	1739	1
5 Resource Management	84	14415	172	83	2001	7
6 Procurement Management	181	24511	135	78	2036	2
7 Stakeholder Management	86	15023	175	89	2555	1
8 External Environment		124443	197	184	1180	1
9 Construction Conditions	1109	118728	107	34	2484	1





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1 SCOPE 2 SCHEDULE 3 COST **4 QUALITY** 9 CONSTRUCTION 5 RESOURCE 6 PROCUREMENT 7 STAKEHOLDER 8 EXTERNAL MANAGEMENT MANAGEMENT MANAGEMENT MANAGEMENT MANAGEMENT MANAGEMENT MANAGEMENT ENVIRONMENT CONDITIONS

Literature Review – Articles Sources



Fig. 2. Percentage of the selected articles published in each journal.

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Fig. 3. Number of selected articles by journals and year of publication.

Literature Review – Articles Distributions





Summary of Literature Review – TOP 10 Risks for Site Conditions

Site conditions



- Unpredicted adverse subsurface conditions
- Differing and unforeseen site conditions
- Lack of readily available utilities on site (e.g., water, electricity, etc.) and unavailability of supporting infrastructure
- Inadequate site investigations (soil tests and site survey)
- Difficulties of access and work on site due to specific geographical constraints of the region
- Late construction site possession
- Unexpected underground utilities encounters
- Delays in the right-of-way process
- Ineffective control and management of traffic
- Improper selection of project location

Summary of Literature Review – TOP 10 Risks for Environmental



Summary of Literature Review – TOP 10 Risks for Health and Safety



Health and safety

- Accidents occurring during construction
- Inadequate safety measures or unsafe operations
- Poor construction safety management
- Damage to persons or property or materials due to poor safety and health management of the project
- Failure to comply with HS&E standards or security plan
- Ineffective protection of surrounding environment (e.g., adjacent buildings and facilities)
- Epidemic illness
- Strict health and safety regulations
- Changed labor safety laws or regulations
- Fatalities

Risk Mitigation – Best Practices

Number (#)	INDUSTRY TOP 5 RISKS	Mitigation Plan
1	Environmental Conditions	Although it is difficult to mitigate risks due to environmental conditions, it is not impossible. A mitigation strategy involves the identification of possible disaster-triggering scenarios and the associated hazard level, analysis of possible consequences for the different scenarios, an assessment of possible measures to reduce and/or eliminate the potential consequences of the danger, recommendation of specific remedial measures and reconstruction and rehabilitation plans, and transfer of knowledge and communication with authorities and society.
2	Subsurface Field Conditions	Subsurface field conditions can be mitigated by explicitly stating the subsurface issues that must be addressed in the project in the solicitation, Including weighted evaluation criteria for subsurface risks in the evaluation plan, and including differing site conditions clause in the contract.
3	Health & Safety	Health and Safety should be a big priority when working in construction. In order to mitigate anything that will put the workers in danger while on the site, there should be job hazard analyses and hazard communication, VR Safety Training, providing of regular training, frequent worksite inspections, emergency response planning, record keeping, and accident analyses, and lastly, there should be a safety manager on site.
4	Skilled Labor, Resources, Materials, & Equipment Shortages	In order to avoid dealing with labor, material, and equipment shortages, it is important to widen the labor pool, offer retaining or advancement opportunities, improve workplaces and processes, procure materials well in advance, be open with clients about the shortage of materials, explore alternative or unconventional materials, and lastly, invest in Lean Construction.
5	Testing & Commissioning	A huge part of commissioning and testing is that it is usually overlooked during construction. Due to being overlooked, many delays tend to happen during construction when certain things are not installed correctly, leading to not getting approval. This could be mitigated by hiring an independent commissioning authority .





