Quest Journals
Journal of Architecture and Civil Engineering
Volume 10 ~ Issue 2 (2025) pp: 08-18
ISSN(Online) : 2321-8193
www.questjournals.org

Research Paper

Mitigation of Delay Risks in Sidewalk Construction Projects in DKI Jakarta Province

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ABSTRACT: *The success of a project is primarily measured by its ability to be completed on time and within budget while maintaining the best quality. Therefore, time or project duration is a crucial constraint in construction project management, such as sidewalk construction projects. The purpose of this research is to identify risk variables, risks analysis, and plan risk mitigation that occur during the implementation phase of the sidewalk construction project in DKI Jakarta, which result in time delays. Data collection in this study used interview and questionnaire survey methods, while data analysis employed the Risk Probability and Impact Assessment and Probability and Impact Matrix methods. The results of this study yielded a risk mitigation plan for 2 (two) dominant risk variables that caused delays in the sidewalk construction project in DKI Jakarta, namely the utility relocation and the undetected existing utility system..*

KEYWORDS: *Sidewalk, Construction, Identify risk, Risk analysis, Risk mitigation, DKI Jakarta, Time delay*

R*eceived 03 Feb., 2025;* ***R****evised 11 Feb., 2025;* ***A****ccepted 13 Feb., 2025 © The author(s) 2025.*
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I. INTRODUCTION

Jakarta continues to organize itself to be on par with global cities. One of the things that must be done to become a sustainable global city according to the G20 Global Goals is to travel in an environmentally friendly way – by cycling, walking, or using public transportation. In addition to that, Jakarta, in order to achieve a Livable City, which is characterized by a comfortable environment and atmosphere as a place to live and as a place for activities, seen from various aspects both physical aspects (urban facilities, infrastructure, spatial planning, and others) and non-physical aspects (social relations, economic activities, and others), must have the availability of public facilities and social facilities and the availability of public spaces as a medium for community interaction. This can be achieved, among other things, by constructing and organizing sidewalks that are comfortable, safe, and aesthetically pleasing using the complete street concept. What is meant by Complete Street is a road whose space allocation and design can accommodate the mobility and activity needs of all road users inclusively, including pedestrians, cyclists, public transport users, and private vehicle users, as well as road users of various ages, genders, women, and people with special needs, and its development is integrated with the construction of infrastructure, facilities, and other public utilities adjusted to the characteristics/context of the developed area. With the complexity of the work and the numerous interests involved in the implementation of the sidewalk construction project in Jakarta, the risks faced are also increasing. The risk of delays is very likely to occur in a construction project. Especially in large-scale infrastructure projects accompanied by high complexity. The main challenge of a project is to achieve the project's objectives while being aware of the constraints, which generally include the scope of work, working hours, and budget for the work. Field dynamics often become an obstacle in meeting the specified timeline. Field dynamics can be due to the owner's mistakes regarding changes in the work or the executor's errors in determining the work methods and the availability of tools, materials, labor, and financial support.

From the data of the sidewalk construction project carried out by the DKI Jakarta Provincial Public Works Department in 2023, there are 5 (five) packages out of a total of 7 (seven) packages that experienced delays. With the existence of these issues, this research will conduct risk identification, risk analysis, and risk mitagion plan during the implementation phase of the sidewalk construction project in DKI Jakarta so that the other project can be completed on time.

II. RESEARCH METHOD

This study used a qualitative descriptive research design. Descriptive research is research intended to collect information about the status of an existing phenomenon, which is the state of the phenomenon as it is at the time the research is conducted, without intending to draw conclusions that apply universally or generalizations. Qualitative research is a research procedure that produces descriptive data in the form of written or spoken words from people and observable behaviors. Qualitative descriptive research is aimed at describing and depicting existing phenomena, whether natural or human-engineered, with a greater focus on characteristics, quality, and the interconnections between activities. The type of qualitative descriptive research interprets and explains the existing data along with the ongoing situation. This research also reveals the attitudes, conflicts, relationships, and perspectives that occur within a group of respondents. The type of qualitative descriptive research is a type of research with a process of obtaining data as it is. This research places more emphasis on the meaning of the results.

The instrument used for data collection in this study is through interviews and questionnaire surveys with respondents, which are subsequently analyzed using Risk Probability and Impact Assessment and Probability and Impact matrix. For a more detailed explanation of the methodology used in this research, please refer to the following image

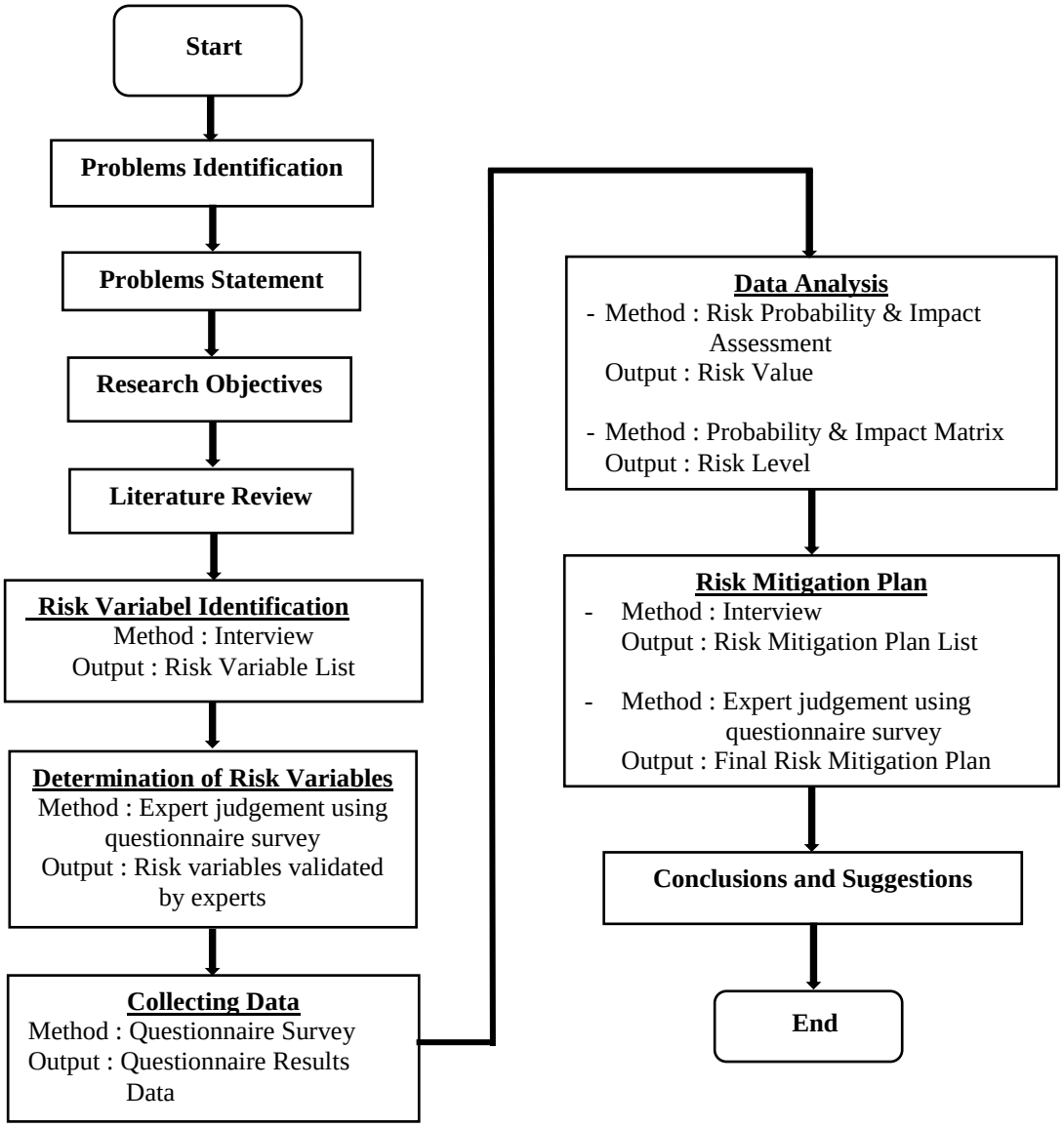

Figure1: Research flowchart

III. RESULTS AND DISCUSSION

In this study, the process of primary data collection was carried out using direct interviews and surveys with experts and respondents. From the data, a qualitative risk analysis is then conducted to identify the dominant risk variables, which will determine a series of agreed-upon actions to be taken in the future, in order to reduce or eliminate the occurrence and/or impact of those risks.

3.1 Risk Indetification

The risk variables in this study were obtained from interviews with 5 (five) representatives from contractors, supervising consultants, and project owners who are experienced in the implementation of sidewalk construction projects at the Public Works Department of DKI Jakarta Province. Then, the results of the interviews were evaluated by expert practitioners in the field of sidewalk construction to validate and enrich the risk variables obtained from the interviews. The risk variables resulting from the interviews and expert assessments are as follows.

Table 1: Risk Variable

Variable	Type Of Risk
X1	Rain during construction time
X2	Landslide during construction time
X3	Flood
X4	Undetected Existing Utility System
X5	Delay in the delivery of materials to the project site
X6	Increase in material prices
X7	Shortage of construction materials
X8	Approval material was delayed by the project's owner.
X9	Difficulty obtaining materials
X10	Increase in the minimum wage
X11	The decision-making process of the company is quite lengthy
X12	Request for the access road by the residents
X13	Relocation of streetlight poles and traffic signs
X14	Company policy changes
X15	The low support from the company's leaders
X16	Delay in the delivery of heavy equipment to the project site
X17	The lack of manpower
X18	Disruption by mass organizations/NGOs
X19	Addition of manpower beyond plan
X20	Project cost estimation error
X21	Difficulties in mobilizing and demobilizing equipment and materials
X22	Plant damage
X23	Construction project equipment damage
X24	Low labor productivity
X25	Loss of materials in the project location
X26	Incompetent workers
X27	Work accidents during construction
X28	Damage/loss of project drawing
X29	Low equipment productivity
X30	Delay in labor payment
X31	Loss of work equipment
X32	Delay in addressing the issue
X33	The delay in supplier payments by the contractor
X34	The supervisor's poor performance in the field in resolving issues
X35	Sudden replacement of core worker
X36	Late start on the project
X37	The project implementation estimate is inaccurate
X38	The implementation schedule does not match what was planned
X39	Work methods are less efficient
X40	Lacking quality control from the owner and consultant

X41	Changes in design/details during the implementation period
X42	Incorrect design drawing
X43	The design is not yet complete
X44	Damage to the clean water pipe during excavation
X45	The work does not meet the specifications.
X46	Change of specifications by the owner
X47	Change in work execution methods
X48	Addition of work scope
X49	Utility relocation
X50	Unclear working drawings
X51	Repairs to houses affected by the project work
X52	Change in contract billing terms
X53	Tree logging permit process
X54	Permits related to access roads for office buildings
X55	Land acquisition that is not yet complete
X56	Poor coordination regarding utility damage repairs
X57	Tree logging
X58	Residents' rejection of sidewalk construction
X59	Low credibility/experience of the contractor in completing job understanding
X60	Utility cables that disrupt work

3.2 Risk Analysis

The identified risk variables were subsequently analyzed using Risk Probability and Impact Assessment through a questionnaire survey of 30 respondents from contractors who have experience in executing sidewalk construction projects in DKI Jakarta. Respondents were asked to assess each of these risk variables in terms of the frequency and impact that cause delays in work time. After the risk assessment, an analysis was conducted using the Probability and Impact Matrix to determine the risk level of each variable in order to decide the next actions to be taken. The results of the analysis of the risk variables can be seen as follows.

Table 2: Risk Analysis Result

Variable	Type of risk	Frequency	Impact	Frequency x impact	Risk Level	Ranking
X49	Utility relocation	0,620	0,397	0,246	High	1
X4	Undetected Existing Utility System	0,667	0,365	0,243	High	2
X60	Utility cables that disrupt work	0,620	0,262	0,162	Medium	3
X57	Tree logging	0,540	0,283	0,153	Medium	4
X41	Changes in design/details during the implementation period	0,533	0,250	0,133	Medium	5
X13	Relocation of streetlight poles and traffic signs	0,473	0,247	0,117	Medium	6
X12	Request for the access road by the residents	0,447	0,258	0,115	Medium	7
X55	Land acquisition that is not yet complete	0,380	0,293	0,111	Medium	8
X43	The design is not yet complete	0,440	0,238	0,105	Medium	9
X18	Disruption by mass organizations/NGOs	0,500	0,207	0,103	Medium	10
X56	Poor coordination regarding utility damage repairs	0,440	0,222	0,098	Medium	11
X1	Rain during construction time	0,447	0,212	0,095	Medium	12
X58	Residents' rejection of sidewalk construction	0,380	0,240	0,091	Medium	13
X38	The implementation schedule does not match what was planned	0,433	0,210	0,091	Medium	14

X48	Addition of work scope	0,407	0,223	0,091	Medium	15
X17	The lack of manpower	0,500	0,173	0,087	Medium	16
X6	Increase in material prices	0,407	0,212	0,086	Medium	17
X42	Incorrect design drawing	0,420	0,202	0,085	Medium	18
X11	The decision-making process of the company is quite lengthy	0,407	0,207	0,084	Medium	19
X16	Delay in the delivery of heavy equipment to the project site	0,433	0,190	0,082	Medium	20
X23	Construction project equipment damage	0,473	0,165	0,078	Low	21
X10	Increase in the minimum wage	0,380	0,200	0,076	Low	22
X44	Damage to the clean water pipe during excavation	0,393	0,188	0,074	Low	23
X40	Lacking quality control from the owner and consultant	0,360	0,200	0,072	Low	24
X59	Low credibility/experience of the contractor in completing job understanding	0,280	0,253	0,071	Low	25
X34	The supervisor's poor performance in the field in resolving issues	0,380	0,187	0,071	Low	26
X39	Work methods are less efficient	0,347	0,200	0,069	Low	27
X47	Change in work execution methods	0,373	0,185	0,069	Low	28
X46	Change of specifications by the owner	0,353	0,193	0,068	Low	29
X32	Delay in addressing the issue	0,340	0,198	0,067	Low	30
X26	Incompetent workers	0,373	0,180	0,067	Low	31
X21	Difficulties in mobilizing and demobilizing equipment and materials	0,447	0,150	0,067	Low	32
X20	Project cost estimation error	0,373	0,177	0,066	Low	33
X5	Delay in the delivery of materials to the project site	0,367	0,177	0,065	Low	34
X36	Late start on the project	0,307	0,203	0,062	Low	35
X29	Low equipment productivity	0,353	0,175	0,062	Low	36
X31	Loss of work equipment	0,320	0,190	0,061	Low	37
X53	Tree logging permit process	0,327	0,183	0,060	Low	38
X25	Loss of materials in the project location	0,333	0,178	0,059	Low	39
X24	Low labor productivity	0,367	0,158	0,058	Low	40
X9	Difficulty obtaining materials	0,287	0,202	0,058	Low	41
X54	Permits related to access roads for office buildings	0,307	0,188	0,058	Low	42
X14	Company policy changes	0,353	0,162	0,057	Low	43
X7	Shortage of construction materials	0,340	0,167	0,057	Low	44
X35	Sudden replacement of core worker	0,313	0,170	0,053	Low	45
X45	The work does not meet the specifications.	0,280	0,190	0,053	Low	46
X33	The delay in supplier payments by the contractor	0,313	0,168	0,053	Low	47
X30	Delay in labor payment	0,313	0,165	0,052	Low	48
X8	Approval material was delayed by the project's owner.	0,307	0,165	0,051	Low	49

X22	Plant damage	0,347	0,143	0,050	Low	50
X37	The project implementation estimate is inaccurate	0,287	0,173	0,050	Low	51
X19	Addition of manpower beyond plan	0,300	0,165	0,050	Low	52
X3	Flood	0,260	0,183	0,048	Low	53
X15	The low support from the company's leaders	0,313	0,145	0,045	Low	54
X27	Work accidents during construction	0,267	0,153	0,041	Low	55
X52	Change in contract billing terms	0,273	0,145	0,040	Low	56
X2	Landslide during construction time	0,247	0,160	0,039	Low	57
X28	Damage/loss of project drawing	0,260	0,143	0,037	Low	58
X51	Repairs to houses affected by the project work	0,233	0,137	0,032	Low	59
X50	Unclear working drawings	0,233	0,123	0,029	Low	60

3.3 Risk Mitigation Plan

The results of the data analysis identified 2 (two) dominant risk factors that can affect the performance time of sidewalk construction work in DKI Jakarta, they are utility relocation and undetected existing utility system. Next, in order to eliminate or minimize these dominant risks, a risk mitigation plan needs to be implemented. The determination of the risk mitigation plan in this study was carried out in two stages: first, interviews were conducted with respondents who rated the two dominant risks highly, and then an assessment was conducted by experts through a questionnaire survey. The risk mitigation plan based on the respondents's case experience and experts judgement is as follows.

Table 3: Risk Mitigation Plan

Case example	Cause	Impact	Risk Mitigation	
			Preventive action	Corrective action
Utility Relocation Risk				
1. Relocation of clean water pipes for the sidewalk construction project at Cikini Raya Street	Procurement of pipe materials that takes a long time	Delay in the construction of the sidewalk on the segment where the relocation of the clean water pipe is taking place.	1. The utility owner prepares sufficient materials and resources for the relocation work. (Utility Owner) 2. During the initial mutal check, the utility owner is also involved so that he can identify and prepare materials for relocation. (Project Owner) 3. The sidewalk design is adjusted to the existing utility conditions so that there is no need for relocation. (Project Owner)	1. Conducting intensive coordination with utility owners for the acceleration of relocation (Project Owner) 2. Adding teams and heavy equipment to carry out relocations. (Utility Owner) 3. Diverting sidewalk work to other segments that are not affected by the relocation work. (Contractor)
2. The relocation of the galvanized gas pipe in the M.T. Haryono Street	1. Galvanized pipe material was not available	1. The work excecution was delayed, causing it to fall behind	1. The utility owner ensures the availability of sufficient	1. Conduct more intensive coordination with utility

Project took 2.5 months		the planned schedule. 2. Costs for workers' wages and equipment rental increase.	materials before the relocation. (Utility Owner) 2. Replacing galvanized pipes with HDPE pipes that are easier to repair and handle for relocation. (Utility Owner)	owners and project owner to expedite material procurement and utility relocation. (Project Owner) 2. Make daily reports on the progress of the gas pipe relocation to the utility relocation WhatsApp group. (Utility Owner)
	2. Long welding work because it must meet gas pressure strength standards	1. The work excecution was delayed, causing it to fall behind the planned schedule. 2. Costs for workers' wages and equipment rental increase.	Relocation work is carried out before the sidewalk project begin. (Utility Owner)	1. Conduct more intensive coordination with utility owners and project owner to speed up the welding work. (Project Owner) 2. Make daily reports on the progress of the gas pipe relocation to the utility relocation WhatsApp group. (Utility Owner)
	3. Coordination with the affected customers takes a long time.	1. The work excecution was delayed, causing it to fall behind the planned schedule. 2. Costs for workers' wages and equipment rental increase	Coordination for relocation is carried out before the sidewalk construction project begin. (Project Owner)	Accelerating coordination with customers affected by relocation. (Project Owner)
3. Relocation of clean water pipes at the Velodrome Street (East Side) Project along 400 meters for 2 months	The existing pipe is old and the material is not available, causing delays in procurement.	Work is delayed waiting for the relocation to be completed	1. Informing utility owners about the planned sidewalk construction location from the previous year so that utility owners can prepare the budget and resources needed for relocation. (Project Owner) 2. Coordinate with the utility owner to relocate the utilities before the project	1. Coordination with the Local Water Supply Utility to expedite the procurement process of pipe materials. (Project Owner) 2. During the relocation, the contractor helped with the excavation. (Contractor) 3. Adding work hours for

			begin. (Project Owner)	relocation. (Utility Owner)
4. The length of time for relocating fiber optic cables along the H.R. Rasuna Said Street	1. The limited number of manpower from the fiber optic relocation vendor	1. The excavation process was halted, causing the work schedule delayed. 2. Cost increase due to schedule delays	Before the project begin, conduct a joint survey with the utility owner to detect existing utilities at the project site and prepare their resources. (Project Owner)	1. Coordination between utility owners, contractors, and project owner is enhanced. (Project Owner) 2. Addition of workers from the vendor to expedite utility relocation. (Utility Owner)
	2. Because there are 5 (five) contractors on one road section, the relocation process is carried out alternately according to priorities (for example in the embassy area	The work schedule is delayed, waiting for the relocation turn.	1. Preparing person in charge for utility relocation in each sidewalk construction work package. (Utility Owner) 2. Relocating utilities that may be affected by the project before the sidewalk construction project begin. (Utility Owner)	1. Coordination between utility owners, contractors, and project owner is enhanced. (Project Owner) 2. Addition of workers from the vendor to expedite utility relocation. (Utility Owner)

Case example	Cause	Impact	Risk Mitigation	
			Preventive action	Corrective action
Undetected Existing Utility System Risk				
1. The discovery of an unidentified gas pipe at the back of the Shangrilla Hotel.	The position of the pipe is not straight (turns around), so it was not detected from the pit test results	1. There was damage to the gas pipe during the excavation. 2. Excavation work has stopped waiting for pipe repairs	1. Before carrying out the work, coordination is conducted with all utility owners to identify the utilities present at the project site. (Project Owner) 2. Utility owners prepare a team to monitor sidewalk construction work so they can promptly prevent damage caused by excavation work. (Utility Owner) 3. Increasing the number of test pits, especially in the intersection area. (Contractor) 4. At the planning stage, utility	1. Coordinate with the utility company to promptly repair the damage caused by the excavation. (Project Owner) 2. Conducting manual excavation to avoid the same inciden (Contractor)

			owners were already involved so that utilities could be identified earlier. (Project Owner)	
2. During the excavation, an optical fiber pipe was found at a depth of 50 cm	The cable installation does not comply with the applicable depth regulations.	1. Excavation work has stopped waiting for the cable relocation 2. The completion of the work did not align with the specified schedule. 3. The costs for worker wages and equipment rental have increased	1. Utility installation is carried out in accordance with the applicable regulations. (Utility Owner) 2. The drawing plan includes the position/location of utilities. (Project Owner)	1. Report to the project owner about the utility that is obstructing the sidewalk project. (Contractor) 2. Coordinate with the utility owner to immediately carry out the relocation. (Project Owner)
3. The presence of an unknown sewerage system at the location on the west side of H.R Rasuna Said Street	There is no data on the location and owner of the sewerage system because it is thought to be an old system	1. The work at that location has been postponed to receive further instructions from project owner. 2. The work is taking longer due to design changes, which have resulted in additional utility relocation tasks.	1. Informing utility owners about the planned sidewalk construction locations from the previous year so that utility owners can identify the affected utilities. (Project Owner) 2. Before construction work begin, a test pit was conducted to determine the location of utilities. (Contractor) 3. Creating a master plan for utility networks. (Project Owner) 4. Managing utility network placement permits to record their locations and owners. (Utility Owner)	1. Making design changes so that the drainage work on the sidewalk does not damage the existing sewage tunnel. (Project Owner) 2. Coordinate with utility owners to promptly relocate the utilities affected by the design changes. (Project Owner)
4. Clean water and electricity utility networks were discovered at ITC Mangga Dua which had not been detected previously	The lack of information regarding utility positions in the project area	1. Damage to utility networks due to excavation work 2. The implementation contractor's progress was reduced due to waiting for the utility network relocation process.	1. Collecting existing utility network data in the project area before the construction work begin. (Project Owner) 2. Increase the number of pit test points. (Contractor)	1. Reporting the presence of utility found during excavation to the Project owner and utility owners. (Contractor) 2. Coordinating with utility owners to expedite repairs and utility relocations. (Project Owner)

IV. CONCLUSION

1. From the identification of risk variables through interviews with contractors experienced in sidewalk construction work within the DKI Jakarta Provincial Public Works Office, and after expert judgement, 60 risk variables were identified that could affect time performance during the implementation phase of the sidewalk construction project.
2. The results of the questionnaire data analysis from 30 respondents identified 2 risk variables with a high (dominant) risk level that could cause delays during the implementation phase of the Sidewalk Construction Project on DKI Jakarta are the utility relocation process that takes a long time and the undetected existing utility system.
3. To reduce or eliminate the occurrence and impact of the dominant risk identified in this study, which is the utility relocation process that takes a long time and the undetected existing utility system, a risk mitigation plan has been developed based on field case examples as follows.
    a. Utility relocation process that takes a long time risk
        1) Preventive action
            a) Utility Owner
                - The utility owner prepares sufficient materials and resources for the relocation work.
                - Replacing existing utility materials with materials that are easier to repair and handle during relocation.
                - Relocating utilities that may be affected by the project before the implementation of the sidewalk construction project.
                - Preparing person in charge for utility relocation in each sidewalk construction work package.
            b) Project Owner
                - Informing utility owners about the planned sidewalk construction locations in the previous year so that utility owners can prepare the budget and resources needed for relocation.
                - Before the project implementation, a joint survey with the utility owner is necessary to detect the utilities present at the project site and prepare its resources.
                - Before the execution of the work, coordination is carried out with the utility owner to relocate the utilities.
        2) Corrective action
            a) Contractor
                - Diverting sidewalk work to other segments that are not affected by the relocation work.
                - Conduct more intensive coordination with utility owners and project owners to expedite relocation.
                - During the relocation process, the contractor assisted with the excavation.
            b) Utility Owner
                - Adding a team and heavy equipment to carry out the relocation.
                - Create daily reports on the progress of utility relocation for the utility relocation communication group.
                - Adding work hours for relocation.
                - Increase in the number of workers from the utility relocation vendor
            c) Project Owner
                - Conducting intensive coordination with utility owners for the acceleration of relocation.
                - Accelerating coordination with utility service users affected by relocation.
                - Coordinating with utility parties to expedite the material procurement process.

    b. Undetected existing utility system risk
        1) Preventive action
            a) Contractor
                - Before the construction of the sidewalk, a test pit was conducted to determine the location of utilities.

- Increase the number of test pits, especially in intersection areas

b) Utility Owner
- Utility owners prepare a team to monitor sidewalk construction work so they can promptly prevent damage caused by excavation work.
- Utility installation is carried out in accordance with the applicable regulations.
- Managing utility network placement permits to record their locations and owners.

c) Project Owner
- Before carrying out the work, coordination is conducted with all utility owners to identify the utilities present at the project site.
- During the planning phase, utility owners were already involved so that utilities could be identified earlier.
- The plan drawing includes the position/location of utilities.
- Informing utility owners about the planned sidewalk construction locations from the previous year so that utility owners can identify the affected utilities.
- Creating a master plan for utility networks.

2) Corrective action

a) Contractor
- Reporting the presence of utility networks found during excavation to the project owner and utility owner.
- Coordinate with utility parties for repairs if there is utility damage due to excavation.
- Conducting manual excavation to avoid damage to utility networks.

b) Project Owner
- Coordinating with utility owners to expedite utility relocation and repair utility damage if it occurs.
- Making design changes if possible to avoid utility relocation

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