# Identification of Risk on Developing Electronic Toll Collection (ETC): An Automated Toll Collection System

**Student Name:** Md. Palash Miah

**Student No :** 0422052072

**Course Name :** Software Project Management (CSE6301)

# 1. Risk names for all identified risks

## 1.1. Project Management Knowledge Area Basis Risk Identification

### i. Integration Management:

- Data Integration Problems: Difficulty integrating the new system with existing toll collection infrastructure can cause operational disruptions.

### ii. Scope Management:

- Scope Creep: Changes in project requirements and scope that are not properly controlled can lead to delays and increased costs.
- Incomplete Requirements: Insufficiently defined requirements can result in a system that does not meet the user's needs.

### iii. Time Management:

- Delays in Deployment: Unforeseen issues during system development and deployment can lead to project schedule overruns.
- Resource Constraints: A lack of skilled personnel or technology resources can impact project timelines.

iv. **Cost Management:**

- Budget Overruns: Underestimating project costs or encountering unforeseen expenses can lead to budget overruns.
- Inaccurate Cost Estimation: Poor initial cost estimation can result in financial challenges.

v. **Quality Management:**

- Inadequate Testing: Failing to thoroughly test the automated toll collection system can result in functionality issues and reduced quality.
- Software Bugs: Coding errors and software defects can lead to system malfunctions and safety concerns.

vi. **Human Resource Management:**

- Skills Shortage: A shortage of skilled personnel with experience in toll collection systems can hinder project progress.

vii. **Risk Management:**

- Technological Failures: Reliance on emerging or unproven technologies can introduce risks related to system stability and performance.

- Security Threats: Cybersecurity vulnerabilities may expose sensitive data and disrupt toll collection operations.

**viii. Procurement Management:**

- Vendor Performance: Dependency on external vendors for hardware or software components may lead to delivery delays or quality issues.

**ix. Stakeholder Management:**

- Resistance to Change: Stakeholders, such as toll operators and users, may resist the transition to automated toll collection systems, affecting project acceptance.
- Communication Challenges: Ineffective communication with stakeholders can lead to misunderstandings and conflicts.

**x. Safety Management:**

- Safety Incidents: Inadequate safety measures during the construction and deployment of toll collection infrastructure can lead to accidents and injuries.

## 1.2. Risk Breakdown Structure Basis Identification

**1. Project Risks**

- 1.1. Scope Management Risks
  - 1.1.1. Scope Creep
  - 1.1.2. Inadequate Requirements Definition
- 1.2. Time Management Risks
  - 1.2.1. Delays in Deployment
  - 1.2.2. Resource Constraints
- 1.3. Cost Management Risks
  - 1.3.1. Budget Overruns
  - 1.3.2. Inaccurate Cost Estimation
- 1.4. Quality Management Risks
  - 1.4.1. Inadequate Testing
  - 1.4.2. Software Bugs

1.5. Risk Management Risks

1.5.1. Technology Risks

1.5.2. Security Threats

1.6. Stakeholder Management Risks

1.6.1. Resistance to Change

1.6.2. Communication Challenges

1.7. Procurement Management Risks

1.7.1. Vendor Performance

**2. Technical Risks:**

2.1. Technical Failures

2.1.1. Hardware Failures

2.1.2. Software Failures

2.2. Data Security Risks

2.2.1. Data Security Breaches

2.3. Operational Risks

2.3.1. Operational Disruptions

2.3.2. Unforeseen Maintenance Costs

2.4. Technology Risks

2.4.1. Technology Obsolescence

**3. User Risks:**

3.1. User Experience Risks

3.1.1. User Experience Issues

3.2. Adoption Risks

3.2.1. Accelerated Adoption

3.3. Change Management Risks

3.3.1. Change Resistance

3.4. Public Perception Risks

3.4.1. Public Perception

**4. Other Risks:**

4.1. Environmental Risks

4.1.1. Environmental Impact

4.2. Natural Disaster Risks

4.2.1. Natural Disasters

## 1.3. Risk List

Following the above risk identification techniques, a total of 21 risks has been finalized below:

- Inadequate Requirements (R1)
- Data Security Breaches (R2)
- Inadequate Testing (R3)
- Scope Creep (R4)
- Budget Overruns (R5)
- Delay in Deployment (R6)
- Security Threats (R7)
- Lack of Skilled Personnel (R8)
- Environmental Impact (R9)
- Cost Saving (R10)
- Operational Disruptions (R11)
- Resource Constraints (R12)
- Unforeseen Maintenance Costs (R13)
- Resistance to Change (R14)
- Natural Disasters (R15)
- Inaccurate Cost Estimation (R16)

- Technology Risks (R17)
- Insufficient Contingency Planning (R18)
- Accelerated Adoption (R19)
- Public Perception (R20)
- System Update and Durability (R21)

## 2. Risk Register for 12 Important Risks

Out of 21 risks, 12 are selected as important risks where 2 are positive and 10 are negative.

*Following 2 risks are identified as Positive,*

| No. | Rank | Risk | Description | Category | Root Cause | Triggers | Potential Responses | Risk Owner | Probability | Impact | Status |
|---|---|---|---|---|---|---|---|---|---|---|---|
| R19 | 1 | Accelerated Adoption | The new system might be so user-friendly and efficient that it encourages more people to use toll roads, | Adoption Risk | User-friendly and efficient system design | Increased user adoption due to system ease of use | Develop marketing campaigns to encourage more people to use the toll roads, monitor adoption rates, Improve and | Marketing Team | Moderate | High | Marketing strategies in place. |

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| | | | increasing revenue. | | | | expand system features to attract more users. | | | | |
| R10 | 2 | Cost Savings | Cost savings result from efficient automation, potentially freeing up funds for reinvestment or optimization | Cost Management Risk | Efficient automation implementation | Successful automation that leads to cost savings | Continuous monitor and assess cost savings, reinvest cost savings into system improvements and optimize processes to maximize cost-saving benefits. | Project Management Team | High | Moderate | Continuous monitoring of cost-saving measures. |

*Following 10 risks are identified as Negative,*

| No. | Rank | Risk | Description | Category | Root Cause | Triggers | Potential Responses | Risk Owner | Probability | Impact | Status |
|---|---|---|---|---|---|---|---|---|---|---|---|
| R4 | 1 | Scope Creep | Scope creep refers to uncontrolled changes or additions to the project's scope beyond the original requirements, leading to potential delays and cost overruns. | Scope Management Risk | Incomplete initial project scope definition | Frequent change requests from stakeholders | Implement a formal change control process and conduct impact assessments before approving scope changes. | Project Manager | Moderate | High | Change control process implemented, but vigilance required. |
| R1 | 2 | Inadequate Requirements | This risk involves insufficiently defined project requirements, which can result in rework, | Scope Management Risk | Insufficient stakeholder engagement and requirements analysis | Frequent and major changes in project requirements | Conduct comprehensive requirements gathering and validation and regularly engage with | Business Analyst | High | High | Ongoing efforts to improve requirements definition processes. |

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| | | | missed expectations, and budget overruns. | | | | stakeholders to clarify requirements. | | | | |
| R6 | 3 | Delay in Deployment | Delays in project deployment can occur due to unforeseen technical challenges or inadequate planning, impacting project timelines. | Time Management Risk | Poor project planning, resource allocation, or unforeseen technical issues | Unforeseen technical challenges or resource shortages | Develop a detailed project schedule with buffer time, regularly monitor progress and resource allocation and have contingency plans for known technical challenges. | Project Manager | Moderate | High | Detailed project schedule in place with buffer time. |
| R12 | 4 | Resource Constraints | Resource constraints, including shortages of skilled personnel or technology resources, can | Time Management Risk | Inadequate resource planning and allocation | Resource shortages, competing project priorities | Identify resource needs early and secure necessary resources and prioritize and allocate | Project Manager | Moderate | High | Ongoing resource allocation challenges. |

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| | | | hinder project progress. | | | | resources effectively. | | | | |
| R5 | 5 | Budget Overruns | Budget overruns result from underestimating project costs or encountering unexpected expenses during development. | Cost Management Risk | Poor initial cost estimation, scope changes, and unforeseen expenses | Frequent scope changes, unexpected costs | Develop a detailed budget with contingency funds, monitor expenses closely and revise the budget as necessary. | Finance Team | High | High | Budget closely monitored with potential for overruns. |
| R7 | 6 | Security Threats | Security threats involve vulnerabilities that can lead to data breaches or system compromise, requiring robust security measures. | Risk Management Risk | Insufficient cybersecurity measures, vulnerabilities | Unusual network activity, security breach attempts | Implement robust security measures and best practices, conduct regular security audits and penetration testing. | Security Team | Moderate | High | Regular security audits and measures in place. |
| R3 | 7 | Inadequate Testing | Inadequate testing can result in software bugs | Quality Management Risk | Rushed testing schedules, | Incomplete testing plans, insufficient | Develop a comprehensive testing plan, | Tester | High | High | Comprehensive testing plan in place but |

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| | | | and operational problems, impacting system reliability and user satisfaction. | | resource shortages | testing resources | allocate adequate resources for testing and quality assurance and conduct thorough testing at each project phase. | | | | continuous monitoring required. |
| R14 | 8 | Resistance to Change | Resistance from toll operators and users to switch to automated systems can hinder system adoption and successful implementation. | Stockholder Management Risk | Lack of effective change management, insufficient communicatio n | Resistance from toll operators and users | Develop a comprehensive change management plan, provide training and support to stakeholders. | Change Management Team | High | Moderate | Ongoing change management efforts and stakeholder engagement. |
| R17 | 9 | Technology Risks | Technology risks arise from rapid advancements or failures in technology, potentially impacting | Technical Risk | Rapid technology advancements , inadequate technology assessment | Emergence of superior technology solutions, technology failures | Stay updated on technology trends and potential disruptions, have backup plans or fallback | Technology Lead | Moderate | Moderate | Continuous monitoring of technology trends and alternatives |

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| | | | system stability and performance. | | | | technologies in case of failures. | | | | |
| R20 | 10 | Public Perception | Public perception risks stem from negative media coverage affecting public trust and support. | User Risk | Negative media coverage, lack of transparency | Negative public feedback or media attention | Engage in proactive public relations efforts, maintain transparency and open communication with the public. | Public Relations Team | Low | Moderate | Proactive public relations efforts in progress. |

# 3. Probability Impact Matrix

For the negative risks, we have to determine probability impact matrix on the following milestones- Project Initiation, Completion of Design, and Before Deployment. And for all mentioned milestones, we have to estimate the probability and impact. That means, for each milestone we will have a total of 20 reasoning (10 probability and 10 impact). So, for 3 milestones we will get a total of 60 reasoning that is described below:

**i) Project Initiation**

| Name of Risk | Probability with Reasoning | Impact with Reasoning |
|---|---|---|
| Scope Creep (R4) | (Medium): At the initiation stage, there is a moderate probability of stakeholders not having a complete understanding of the toll collection project's scope, leading to potential changes as they gain more clarity. | (High): Scope changes at this point can significantly impact the project's objectives and budget, potentially setting a problematic precedent. |

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| Inadequate Requirements (R1) | (Medium): Inadequate requirements are more likely to be identified early, but they can still occur due to evolving needs or unclear initial project understanding. | (High): Such inadequacies can lead to costly rework and delays, impacting project timelines and budgets. |
| Delay in Deployment (R6) | (Low): Delays can occur due to various factors, such as system technical challenges or changes in scope, even at the project's early stages. | (Medium): While delays can be problematic, they might not have a severe impact on the project's overall timeline at this point. |
| Resource Constraints (R12) | (Medium): Resource constraints required for toll system may be recognized at the beginning of the project, but they may not be as critical as the project has just started. | (Medium): Limited resources can affect project progress but might not be as detrimental as at later stages. |

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| Budget Overruns (R5) | (Medium): While budget overruns are a concern from the start, they are less likely to occur in the initial phases compared to later stages. | (High): Any budget overruns at this stage can set a worrying precedent for the project's financial management. |
| Security Threats (R7) | (Low): Security threats may be less likely to manifest at this early stage when the system is not yet fully developed. | (Low): Security breaches during this phase may have limited consequences, given the limited system functionality. |
| Inadequate Testing (R3) | (Medium): Inadequate testing can be identified as a risk early on, but it may not be as critical as our project is just starting. | (Low): Inadequate testing at this stage can result in design revisions but may not severely impact the overall project timeline. |
| Resistance to Change (R14) | (Medium): Resistance to change may start to emerge as stakeholders become more involved, but it might not be as pronounced as in later phases. | (Low): While resistance can disrupt the project, its impact at this stage is likely limited. |

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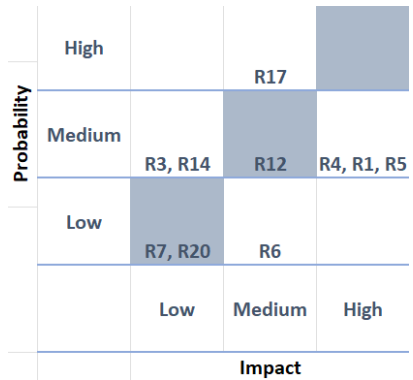
| Technology Risks (R17) | (High): Technology risks remain relatively high from the start, as they are inherent to the project's technical nature. | (Medium): Technical issues at this stage can result in design adjustments but may not cause severe delays. |
| Public Perception (R20) | (Low): Public perception may not be a significant concern at the initiation stage when the project is not yet visible to the public. | (Low): Negative public perception is less likely to occur or significantly affect the project at this point. |



**ii) Completion of Design**

| Name of Risk | Probability with Reasoning | Impact with Reasoning |
|---|---|---|
| Scope Creep (R4) | (Medium): There is a moderate likelihood of scope changes or additions as stakeholders gain a clearer understanding of project requirements during the design phase. | (High): Scope changes at this point can significantly impact the project's objectives, design integrity, and budget. |
| Inadequate Requirements (R1) | (High): As the design phase progresses, the likelihood of discovering inadequate requirements or gaps increases. | (High): Incomplete or unclear requirements can lead to costly design revisions and potential delays. |
| Delay in Deployment (R6) | (Medium): Delays are more critical at this stage, with various technical and design elements needing alignment before deployment. | (Medium): Missing the deployment deadline can have consequences, affecting project stakeholders and users. |

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| Resource Constraints (R12) | (Medium): Resource constraints may be more pronounced at this phase, with design requirements becoming clearer. | (Medium): Limited resources can impact the quality and timely completion of design tasks. |
| Budget Overruns (R5) | (High): The risk of budget overruns increases as the project reaches the completion of the design phase due to evolving design needs. | (High): Budget overruns at this stage can jeopardize the financial viability of the project and necessitate redesign efforts. |
| Security Threats (R7) | (Medium): As the project's technical aspects are solidified, the risk of security threats becomes more significant. | (Medium): Security breaches during this phase can lead to substantial data loss or system compromise. |
| Inadequate Testing (R3) | (Medium): The complexity of the design phase increases the likelihood of identifying new testing requirements or issues. | (Medium): Inadequate testing at this stage can result in costly design revisions and potentially delay deployment for our project. |

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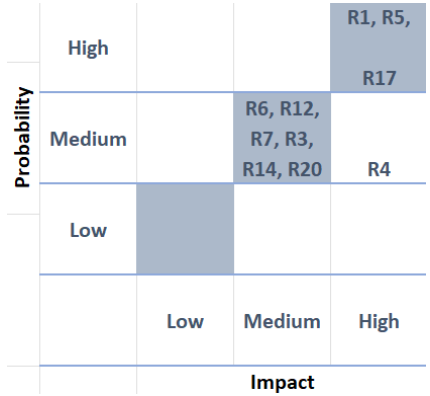
| Resistance to Change (R14) | (Medium): Resistance to change may intensify as design decisions are finalized, impacting design efficiency. | (Medium): While resistance can disrupt the design process, its impact at this stage is likely manageable. |
| Technology Risks (R17) | (High): Technology risks continue to be significant during the design phase as technical challenges become more apparent. | (High): Technical issues at this stage can lead to design revisions, potentially delaying deployment. |
| Public Perception (R20) | (Medium): Public perception may start to become a concern as the project design nears completion and becomes more visible. | (Medium): Negative public perception at this stage can affect stakeholder confidence but may not have severe consequences. |




## iii) Before Deployment

| Name of Risk | Probability with Reasoning | Impact with Reasoning |
|---|---|---|
| Scope Creep (R4) | (Medium): Scope creep is more likely to occur as the project nears deployment, with stakeholders seeking last-minute changes. | (High): Scope changes before deployment can severely impact the project's timeline, budget, and success. |

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| Inadequate Requirements (R1) | (High): Inadequate requirements can become a critical issue as the project approaches deployment, leading to design or implementation problems. | (High): Incomplete or unclear requirements at this stage can lead to significant delays and cost overruns on our project. |
| Delay in Deployment (R6) | (High): Delays are particularly problematic before deployment, as missed deadlines can lead to serious operational issues. | (High): Delaying deployment can have substantial consequences, affecting project stakeholders and user satisfaction. |
| Resource Constraints (R12) | (High): Resource constraints are more critical before deployment, where adequate resources are crucial for a successful launch. | (High): Lack of necessary resources at this stage can lead to deployment failures or compromises in quality. |
| Budget Overruns (R5) | (High): The risk of budget overruns could be high before deployment, as unforeseen costs and changes become more apparent. | (High): Budget overruns at this stage can entirely jeopardize the entire project's financial viability and successful deployment our project. |

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| Security Threats (R7) | (High): Security threats remain a significant concern before deployment when the system becomes more exposed. | (High): Security breaches before deployment can have severe consequences, affecting user data and public trust to the toll system. |
| Inadequate Testing (R3) | (High): Inadequate testing is a substantial risk before deployment, as thorough testing is essential for a successful launch. | (High): Insufficient testing at this stage can result in deployment failures and a compromised user experience. |
| Resistance to Change (R14) | (High): Resistance to change may intensify before deployment, affecting the adoption of the new system. | (High): Resistance can disrupt the deployment process and impede the successful transition to the new system. |
| Technology Risks (R17) | (Medium): At this time technological risk can be reduce to minimal, cause now we have the better understanding on entire system deployment. | (Medium): Technical issues at this stage can lead to design revisions, potentially delaying deployment. |

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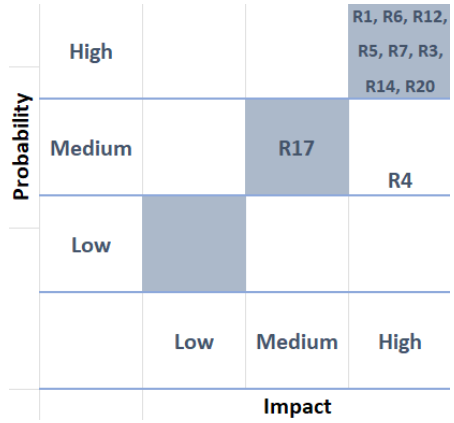
| Public Perception (R20) | (High): Public perception becomes a critical concern before deployment, as our project will become more visible and accountable to the public. | (High): Negative public perception can significantly impact the project's reputation and success, potentially leading to legal or regulatory issues. |



## 4. Top 5 Negative Risk Item Tracking Chart

From above, among 10 negative risks, the top 5 risks are, Scope Creep, Inadequate Requirements, Delay in Deployment, Resource Constraints, Budget Overruns. Using those risks events, the Risk Item Tracking Chart on different milestone has been provided below:

| Risk Item | Rank (at the time of project initiation) | Rank (at the time of completion of design) | Rank (at the time of before deployment) | No. of Times Enlisted on the Rank List During those Milestone Period | Risk Resolution Progress |
|---|---|---|---|---|---|
| Scope Creep | 4 | 4 | 2 | 2 | Conducting a thorough review of project requirements and communicating changes through a formal change control process |
| Inadequate Requirements | 1 | 3 | 5 | 3 | Scheduled comprehensive requirements review meetings with ETC project |

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| | | | | | stakeholders for more clarification and refine project requirements |
| Delay in Deployment | 3 | 2 | 1 | 3 | Expediting the project timeline by closely monitoring critical path activities and allocating additional resources if needed |
| Resource Constraints | 2 | 1 | 4 | 3 | Assessed resource allocation, considered outsourcing options, and optimized resource utilization |
| Budget Overruns | 5 | 5 | 3 | 2 | closely monitoring project expenses, implementing cost-saving measures, and ensuring adherence to the budget throughout the project |