# 20GEO03 – Design Thinking for Engineers

## List of Templates for CAT I (T1 to T16)
## (Explore Phases)
## 16 Templates

# Phase I : Explore

# List of Templates for CAT 1

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- **T2:** SCOPES
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# T1 : PMA 1 - Design Brief

| | DESIGN BRIEF |
|---|---|
| PROJECT DECRIPTION | Develop an advanced IoT-based landslide detection and early warning system to monitor environmental and geotechnical parameters, providing real-time alerts to prevent loss of life and property. |
| INTENT SCOPE | **Within the scope:** Installing IoT sensors, analyzing data, developing predictive models, and setting up community alerts.<br>**Outside the scope:** Infrastructure repair, long-term environmental monitoring, policy-making, and extensive public education programs. |
| EXPLORATION QUESTIONS | **How can IoT sensors be effectively utilized to monitor and predict landslide occurrences?**<br>**What are the most effective methods for processing and analyzing the collected data to provide accurate and timely landslide warnings?** |
| TARGET USERS | **1. Local Authorities and Government Agencies**<br>**2. Residents in Landslide-Prone Areas**<br>**3. Infrastructure and Utility Companies**<br>These communities are important because they are at high risk of losing lives, homes, and livelihoods due to landslides. By providing early warnings and predictive insights, we can help them take preventive measures, ensuring their safety and minimizing damage. |
| RESEARCH PLAN | To explore the opportunity space, we will conduct a thorough market analysis to identify the needs and challenges of target users, and engage with stakeholders through surveys and interviews to gather insights and validate the feasibility of the IoT-based landslide detection system. |
| EXPECTED OUTCOMES | The expected outcomes include the development of a reliable IoT-based landslide detection system that provides real-time alerts, enhancing safety and preparedness in landslide-prone areas. |
| SUCCESS METRICS | Success will be measured through several Key Performance Indicators (KPIs):- **Accuracy of Predictions, Timeliness of Alerts, Reduction in Landslide Impact.** |
| PROJECT PLANNING | We need IoT sensors and data analysis software for detecting landslides, crucial during the data collection and analysis stages. These resources are essential to gather accurate data and predict potential landslides effectively. The urgency is driven by the upcoming monsoon season, which increases the risk of landslides. The relevant timeframe for fulfilling the brief is three months to ensure timely implementation and safety measures. |

# T2 : SCOPES (Design Challenge)

| | SCOPES | DEFINITIONS |
|---|---|---|
| S | **SITUATION AND/OR PROBLEM** | Landslides pose a significant threat to life and property in many regions, often occurring with little warning. The challenge is to develop a reliable system that can provide early detection and timely alerts to mitigate these risks. |
| C | **CONTRAINTS** | The project faces constraints such as limited budget for sensor deployment and maintenance, and the challenge of ensuring reliable wireless communication in remote, landslide-prone areas. Additionally, the system must be robust enough to operate under harsh environmental conditions. |
| O | **OBJECTIVES AND OUT-COMES** | **Objectives:**<br>Develop an IoT-based system for early landslide detection and real-time alerts to enhance safety and preparedness.<br>**Expected Outcomes:**<br>Timely alerts to prevent loss of life and property, and valuable data for improving landslide prediction models. |
| P | **PEOPLE** | The primary beneficiaries are residents living in landslide-prone areas, who will receive timely alerts to ensure their safety. Additionally, local authorities and disaster management agencies will benefit from real-time data to make informed decisions and coordinate emergency responses effectively. |
| E | **ESTIMATES** | |
| S | **SCOPE** | There is ample scope to explore multiple alternatives, such as using different sensor types and configurations, various communication technologies, and diverse data processing techniques. These alternatives can help optimize the system for different terrains and conditions. |
| | **DESIGN CHALLENGE** | How might we develop a reliable and scalable IoT-based landslide detection system that provides real-time alerts to enhance safety and preparedness in landslide-prone areas? |

# T3 : STEEP TRENDS ANALYSIS

## Social and demographics

1. Increasing awareness of natural disaster risks.
2. Higher population density in landslide-prone areas increases the need for effective monitoring systems.

## Technologies

1. Continuous improvements in IoT technology, including sensors, networks, and data processing, enhance system reliability and accuracy
2. The durability and power efficiency of sensors are critical for long-term deployment .

## Economy

1. Initial costs of sensor installation, network setup, and maintenance could be high.
2. The cost of landslide damage (property, infrastructure) can justify the investment.

## Environment and Nature

1.Heavy rainfall
2.Extreme weather conditions
3.Soil erosion and vegetation damage
4. Designing sensor systems that have low environmental impact

DESIGN CHALLENGES

## Politics and Legal

1.Potential for government funding and support through dedicated disaster risk reduction programs
2.Ensuring compliance with environmental protection laws and land use policies.

# T4 : STEEP Analysis Matrix

STEEP ANALYSIS MATRIX

High Impact

1.The interaction of multiple hazards may vary, impacting detection systems effectiveness.
2.Integration may be complex and variable , affecting effectiveness

1.Climate change impacts are substantial and expected to continue influencing landslide frequency.
2.Technological advancements in sensors and monitoring are expected and impactful.

Uncertain to Occur

Likely to Occur

1. Regulations may vary and impact system implementation unpredictably
2. New tech may have potential, but its practical impact and adoption are uncertain.

1. Changes in land use are ongoing but may have less immediate impact on detection systems.
2.Routine updates and improvements are generally expected but may have less immediate impact

Low Impact

# T5 : STEEP Analysis Prioritization

**STEEP ANALYSIS PRIORITIZATION**

Discuss 2 key trends from the High Impact - Likely to Occur quadrant:

1. This quadrant prioritizes areas with high landslide risk and a high probability of occurrence. These zones require immediate attention and mitigation strategies.
2. This analysis provides a framework for prioritizing landslide mitigation efforts by focusing on areas with the highest risk.

Discuss 2 treds from the High Impact - Uncertain to Occur quadrant

1. These areas have the potential for significant damage and disruption, even if the likelihood of a landslide is uncertain.
2. This quadrant necessitates ongoing monitoring of environmental factors, such as rainfall and seismic activity, to refine the probability of a landslide occurrence.

# T6 : Strategic Priorities Matrix

**STRATEGIC PRIORITIES MATRIX**

| | URGENT | LESS URGENT |
|---|---|---|
| IMPORTANT | These tasks are critical and need immediate attention. They directly impact the ability to detect and respond to landslides in real-time. | These tasks are essential for long-term effectiveness and sustainability. |
| LESS IMPORTANT | These tasks require quick action but might not have the same long-term impact. They are often short-term fixes or communications. | General awareness campaigns that are not related to immediate disaster response.. |

# T7 : Synthesis (Sense Making)

**SYNTHESIS: MAKING SENSE OF STEEP ANALYSIS AND STRATEGIC PRIORITIES**

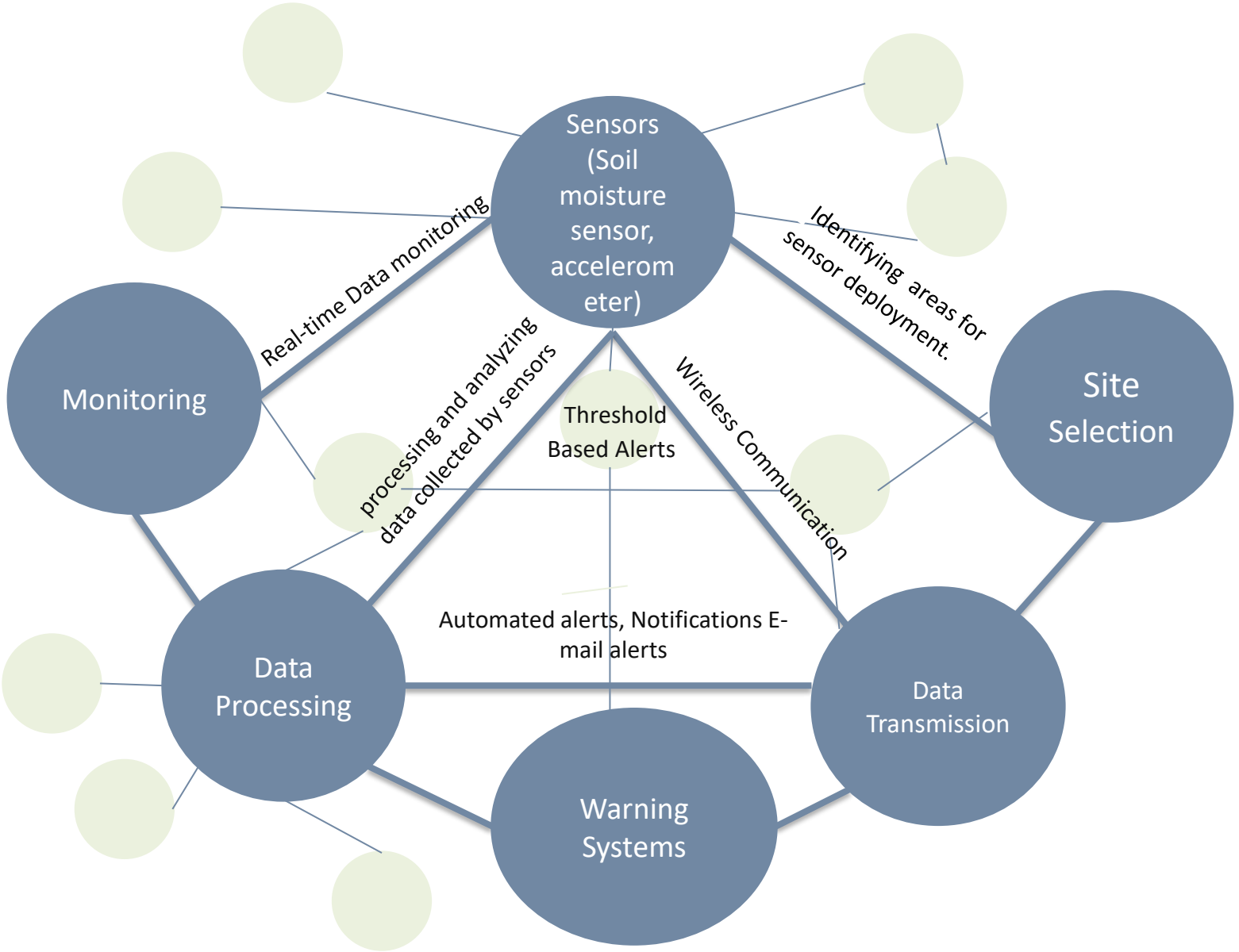
| Assessment Questions | Synthesis: Sense Making |
|---|---|
| What relationships among the trends do you perceive? How are they related? Why are these relationships important? | Increasing urbanization, climate change, and advancements in IoT technology. |
| What opportunities and/or challenges need immediate attention going forward for your design challenge? And why? | Leveraging IoT sensors for real-time monitoring, utilizing machine learning for data analysis and prediction, and integrating data with GIS for visualization and decision-making. |
| What would it take to create positive change on this issue relating to your design challenge? | Engaging stakeholders like government agencies, research institutions, and local communities. Implementing regulations for land use and construction in landslide-prone areas. |
| Who else wouold be interested in this issue? Why should they care? What conversations would you have with them? | Government agencies, disaster management companies, and communities at risk. Preventing loss of life and property, protecting infrastructure, ensuring environmental sustainability, and managing financial risk. Discussing the potential impact of IoT-based landslide detection. |

# T8 : Activity System Mapping

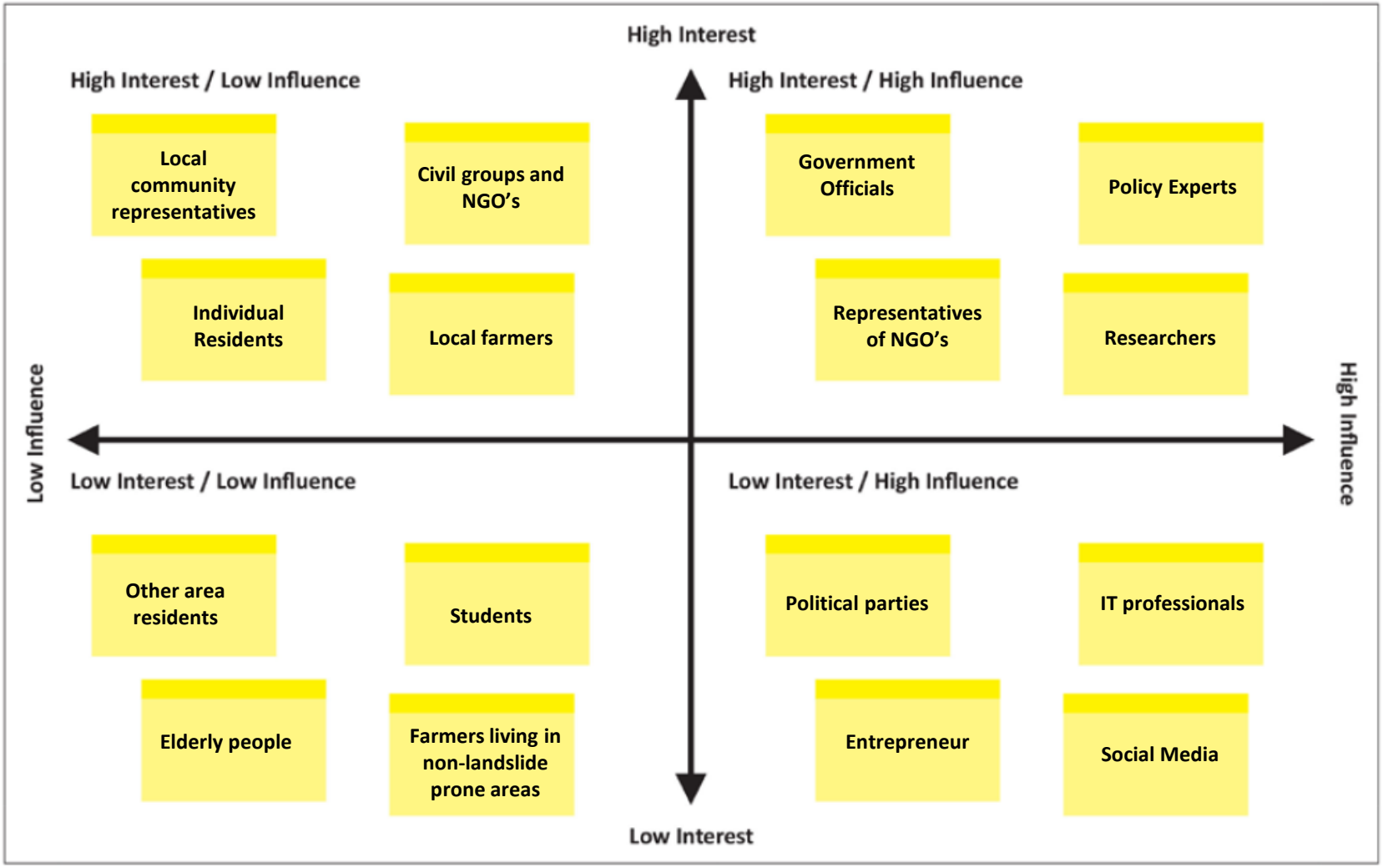
**OBJECTIVES**

| Risk assessment | Mitigation Strategies | Early warning Systems | Emergency Preparedness |
|---|---|---|---|
| Identifying landslide-prone areas | Vegetation management | Install Sensors | Improve preparedness |
| Determining slope stability | Retaining Drainage systems | Implement real-time monitoring | Alert residents and stakeholders |
| Analysing rainfall patterns | Ensure effective runoff management | Disseminate early warnings through SMS,etc. | Train first responders |
| Determining soil type | Terracing | Geophysical modelling | Establish Evacuation protocols |

# T9 : Key Components of Activity System

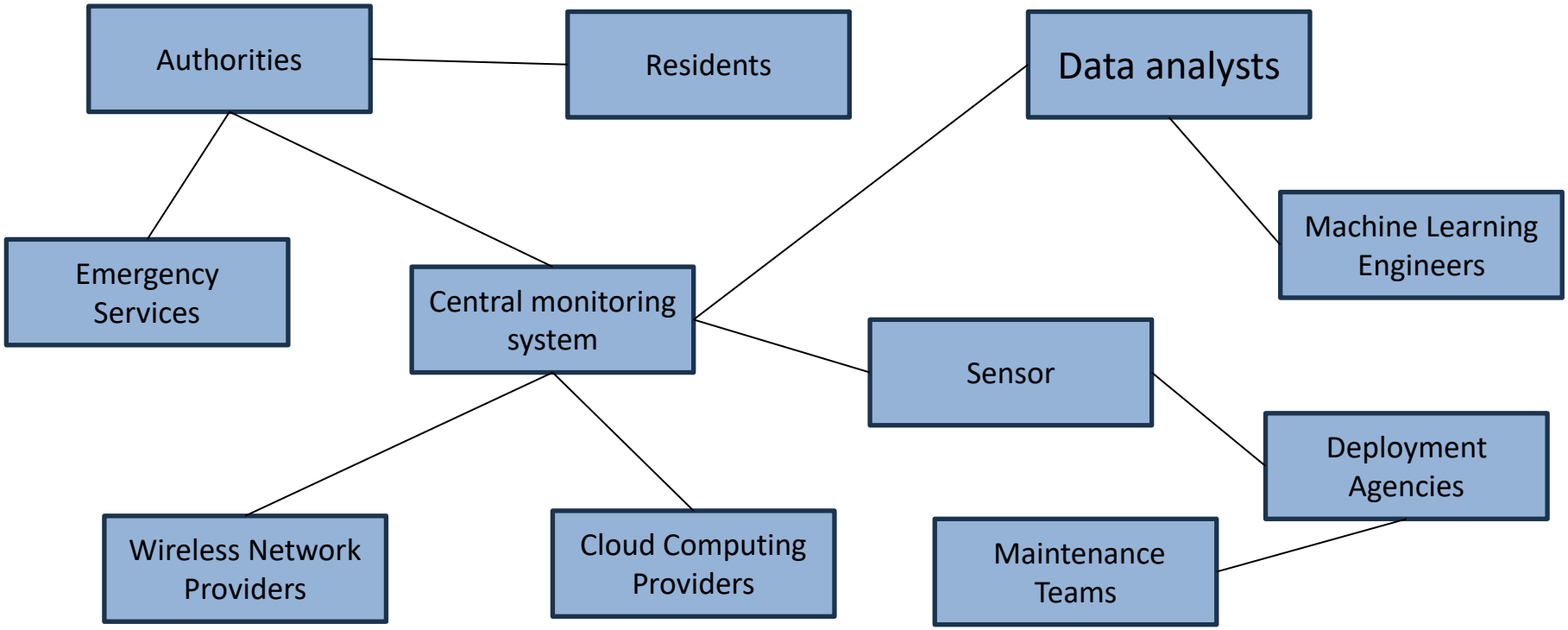


# **T10:** Stakeholder Mapping Matrix



# **T11:** Stakeholder Links & Relationship Mapping

- Define the links and relationships between stakeholders.



# **T12:** Stakeholder Priority Mapping Matrix

HIGH INTEREST

| | |
|---|---|
| **KEEP SATISFIED**<br><br>**1)Researcher**<br>**2)Local Community Member** | **ENGAGE CLOSELY**<br><br>**1)Leading Researchers**<br>**2)Directors of NGOs**<br>**3)High Level Consultants in risk management** |
| MONITOR(Minimum Effort)<br><br>1)Volunteers or Community Helpers<br>2)Interns level Employees<br>3)Informal Advisors | KEEP SATISFIED<br><br>1)Government Officials<br>2)Policy Maker |

LOW INFLUENCE

HIGH INFLUENCE

LOW INTEREST

# T13: Stakeholder Analysis & Engagement Strategy

| KEY STAKEHOLDERS | RELATIONSHIPS | STAKEHOLDERS INTEREST IN DESIGN CHALLENGE | IMPACT ASSESSMENT | STRATEGIES TO GAIN SUPPORT OR REDUCE OBSTACLES |
|---|---|---|---|---|
| Researcher | Geotechnical Engineers | High | Effective in translating research into practical solutions. | Translate into real world scenerios |
| Director of NGOs | Focuses on Monitoring | High | Ability to leverage funding ,resources effectively. | Maintain open lines of Communication |
| Policy Makers | Responsible for Implementing Regulations | Medium | Efficiency in resource allocation | Develop streamline process |
| Local Community Members | Users or Main character | High | Effectiveness of individual mitigation efforts. | Provide financial assistance |
| **Insurance Companies** | **Responsible for lives and properties** | **High** | **Efficiency in managing claims,supporting recovery.** | **Provide assistance for landslide related damages** |

# T14: Project Brief and Opportunity Framing

## A. CHALLENGE OR PROBLEM DEFINITION

| | | |
|---|---|---|
| **PROJECT SPONSOR** | **Organization Name** | Kongu Engineering College |
| | **Address and Contact** | Perundurai, Erode – 638 060<br>Ph.no : 04294 226555 |
| | **Contact Person(s)** | |
| **PROJECT TITLE** | **Landslide Detection using IOT Devices** | |
| **DESIGN CHALLENGE** | Real time landslide detection that can accurately predict and provide warnings to minimize damage and loss of life. | |
| **DESIGN CHALLENGE CONTEXT AND BACKGROUND INFO** | **ISSUE:**<br>• Loss of life and Property.<br>**OPPORTUNITY:**<br>• To provide early warning system and ecosystem protection. | |
| | Why does this design challenge matter to the organization ? | Addressing real world problem.<br>Reputation and Social Responsibility. |

## A.CHALLENGE OR PROBLEM DEFINITION (contd…)

| | | |
|---|---|---|
| **GOALS AND OBJECTIVES OF THE DESIGN CHALLENGE** | **GOALS:**<br>➢ Less manpower.<br>➢ More belief in the system. | **OBJECTIVES:**<br>➢ To provide accurate observations in less time without errors. |
| **TARGET USERS OF THIS DESIGN CHALLENGE** | Residents in landslide prone areas, infrastructure and utility companies. | |
| **OTHER KEY STAKEHOLDERS** | R&D Department , Project Management Office. | |
| **PREVIOUS EFFORT TO SOLVE THIS DESIGN CHALLENGE** | They experimented many techniques including Sensor Network,Remote Sensing & GIS. | |
| **CURRENT ACTIVITY SYSTEM AND PROCESS** | The image processing unit in IR sensors | |

# T15: Project Brief and Reframing Project Challenges

## B . OPPORTUNITY FRAMING

| | |
|---|---|
| **Real issues behind this design challenge** | |
| **Inspiration from others in solving the design challenge** | *Sensors based*<br>*Landslide detection* |
| **Team contributions** | **23CSR129** **23CSR182**<br>**23CSR138** **23CSR184**<br>**23CSR169** **23CSR186** |
| **Success Criteria** | *Completion of project within scheduled time and successful Landslide detection* |
| **"How might we" opportunity/possibility statement** | *How might we design real time landslide detection system to prevent loss of life and property?* |

# **T16**: Reframing the Opportunities

**Reframe your opportunities and filter one**

**"How might we……?"**

1. "How might we……?"
2. "How might we……?"
3. "How might we……?"