School of Science, Computing and Engineering Technologies

COS10025

Technology in an Indigenous Context Project

Business Case and Project reflection report

Project Title: Sustainable Energy System in Phu Tho

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Xuan Son, nestled in the heart of Phu Tho province, is a picturesque haven located approximately 80 km from the vibrant Việt Trì City. This park covering an impressive area of 15,048 hectares (37,180 acres). The crown jewel of this breathtaking expanse is the majestic natural forests, extending over 11,000 hectares (27,000 acres) and enveloping visitors in a serene embrace of lush greenery. Adding to its allure, the park is adorned with 1,396 hectares (3,450 acres) of mesmerizing limestone-mountain forests.

Declaration

I declare that this report is my individual work. I have not copied from any other student's work or from any other source except where due acknowledgment is made explicitly in the text, nor has any part of this submission been written for me by another person.

Signature: *NGUYEN MANH DUNG*

Part A: Business case

Executive Summary

This business case brief thoroughly assesses various design options for a solar energy implementation project in Xuan Son, Phu Tho. Over 11,000 hectares of natural woods and 1,396 hectares of pure limestone-mountain forests make up its 15,048 hectares of sizeable land, which is blessed with an abundance of natural resources, according to Wikipedia. However, due to the community's reliance on non-renewable energy sources, which has led to issues with access to key services, environmental deterioration, and energy constraint,(Nguyen et al., 2019).

Because of that, It is proposed in this case that GRASS GIS, a geospartial software, can be implemented to overcome those problems. GRASS GIS is a powerful open-source software for geospatial data analysis and visualization. With a user-friendly interface and extensive tools, it enables informed decision-making and sustainable development.

Uplifting Xuan Son's livelihoods through increased connectivity is the primary focus of this transformative project. GRASS GIS implementation offers a sustainable energy solution, empowering the community, creating economic opportunities, and preserving the environment. A brighter, prosperous future awaits Xuan Son as a leader in sustainable practices, fostering shared value and long-term sustainability for generations to come.

Introduction (Project Description & Motivation)

Xuan Son, a beautiful areas, which located around 80 kilometers from Viet Tr City. More than 11,000 hectares (27,000 acres) of natural forests and 1,396 hectares (3,450 acres) of limestone-mountain forests make up the park's 15,048 hectares (37,180 acres) of total land area. This rural sanctuary offers a tranquil atmosphere, ample resources, and lush vegetation, making it the ideal place to install solar energy systems and start revolutionary community development. The goal is to move this rural area toward modernity while keeping its allure by adopting a vision of development.

Nonetheless, the community of Xuan Son suffers significant difficulties, chiefly as a result of its preponderant reliance on non-renewable energy sources. Such dependencies have numerous, far-reaching effects. The region's enduring energy shortage is one of the most urgent problems. Frequent power outages and an unpredictable electrical supply have developed into widespread issues that negatively affect businesses, industries, and residents' daily lives. Such energy shortages cause economic disruptions, which result in losses of money and limit the region's capacity for growth and development. The region's economic development is significantly hampered by the lack of power, which also makes it difficult to acquire basic services and jeopardizes educational possibilities. High energy prices and an unstable power supply make it difficult for businesses to flourish, which reduces job possibilities and impedes the region's economic growth.

The motivation of this solar system implementation project is to elevate the business circumstances in Xuan Son. The community's reliance too much on non-renewable energy resources has resulted in energy scarity and environmental harm. Limited availability of electricity affects economic growth, inhibit access to essential services, and delimit educational opporturnties. The heavy reliance on fossil fuels also contributes to greenhouse gas emissions, further exacerbating climate change and threatening the region's natural ecosystems. These energy challenges harmper economic development, hinder educational opportunities, and impede access to modern amenities.

The vision of the Solar System Implementation Project is to harness the abundant solar resources of Phu Tho township and create a transformative impact on its energy landscape. With a strong focus on sustainability, this project seeks to promote eco-friendly practices by replacing traditional fossil fuels with clean and renewable solar power. By installing solar panels and associated infrastructure, the community can significantly reduce its carbon emissions and take a significant step towards a greener and healthier future for generations to come,(Zhang et al., 2021).

At the heart of the project lies the development of a functional prototype of the solar energy system. Through rigorous testing and iterative improvements, the solar system will be optimized to efficiently capture and utilize solar energy. A meticulous budget analysis ensures that the project remains financially feasible, allowing for effective resource allocation and maximum impact, (Hofierka & Suri, 2002). Beyond just installing the solar system, the project emphasizes knowledge dissemination among the local community. Educational materials in the form of videos, infographics, and interactive websites are developed to raise awareness about the potential of solar energy and its benefits.

This project is more than just a technical endeavor; it is about empowering the community with knowledge and long-term engagement. A comprehensive impact assessment will evaluate the project's success, considering factors such as reduced carbon emissions and improved energy access.

Environmental preservation is a top priority in the project, as it significantly reduces dependence on fossil fuels, aligning with global sustainability goals,(Arrow & Fisher, 1974). Careful planning and advanced simulation tools ensure that the solar system is efficient and long-lasting, reducing maintenance requirements.

The Solar System Implementation Project aims to revolutionize how energy is harnessed and utilized in Phu Tho. It pioneers cutting-edge technologies to optimize solar energy generation, making it an economically viable and inclusive alternative for all members of the community. By providing educational resources and training, the project empowers local residents with the skills to maintain and optimize the solar infrastructure, fostering a sense of ownership and contributing to economic resilience and self-sufficiency.

Summary of project budget (all design ideas)

Design concept/solution 1 (Nguyen Manh Dung): Implement a layout that encourages eco-friendly habits, energy efficiency, and a healthy environment for peoples.

Number	Resources	Quantity	Estimate cost	Total
1	**Component/ devices costs**			
	Laptop	2-3 devices	1000-2000	$2000-$3000
2	**Labour costs**			
	Coder	2-3 person for each devices	30000$ per annual for implementing 10000$ per annual for system warranty	$40000
3	**Installation/ Implementation cost**			
	AWS (RDS Database)	1	118,052$ per annual (after free-tier)	$118,052
	Grass GIS	1	Free (Open-source)	$0
	Total estimate			**$160,052**

Design concept/solution 2 (Tran Hai Long): Implement a satellite connection

Number	Resources	Quantity	Estimate cost	Total
1	**Component/ device costs**			
	MediaTek MT6825	50 panels	$100	$5000
2	**Labour costs**			
	Tester	1	$10000	$10000
	Developer	2	$30000 (including maintenance)	$60000
3	**Installation/ Implementation costs**			
	Microsoft Azure Space	1	$71556 per annual	$71556
Total estimate				$146.556

Design concept/solution 3 (Tran Yen Nhi, Nguyen Tran Yen Binh): Implementing a software system that enables real-time monitoring and control of the solar energy system is essential for maximising its efficiency and effectiveness.

No	Resources	Quantity	Estimate cost	Total
1	**Component/ device costs**			
	Solar Irradiance Sensor: Pyranometer	2	$200-$600	$400-$1200
	Temparature Sensor: Thermocouple Sensor	2	$50-$100	$100-$200
	Battery Charge Level Sensor: Voltage Sensor	2	$20-$50	$40-$100
	Antennas: Panorama LPB low profile antenna	1	$50-$80	$50-$80
	Industrial Ethernet Switch: Moxa EDS-205A	1	$100-$150	$100-$150
	Network Cables: CAT6 Ethernet Cables (Various Lengths)	1	$50-$100	$50-$100
2	**Labour costs**			
	Electrician	2	$100-$500	$200-$1000
	Quality Assurance Engineer	1	$300-$500	$300-$500
	Technical Writer	1	$1000-$2000	$1000-$2000
3	**Installation/Implementation costs**			

	SCADA Software: Ignition SCADA Software by Inductive Automation	1	$2000-$5000	$2000-$5000
	Security and Encryption: SSL/TLS Certificates: $50 to $150	1	$50-$150	$50-$150
4	**Other essential costs**			
	Licensing: Client Access Licenses (CALs) for remote monitoring	1	$200-$500	$200-$500
	Wireless Modems/Routers: Sierra Wireless AirLink RV50X	1	$600-$800	$600-$800
	Total estimate			$5280-$11.780

Design concept/solution 4 (Tran Hoang Hai Anh): Creating a comprehensive framework of support that includes local empowerment, technical help, and education to empower rural people to run and maintain sustainable solar energy systems efficiently.

Number	Resources	Quantity	Estimate cost	Total
1	Component/ device costs			
	Monitoring equipment:	2	$500	$1000
	Remote systems	2	$150	$300
2	Labour costs			
	Technicians	1	$2000 per month	$24000 per annual
	Local trainers	1	$1000 per	$12000 per

			month	annual
3	**Installation/Implementation costs**			
	Collaboration setup	1	$300	$300
	Support materials	2	$100	$200
4	**Other essential cost**			
	Training materials	1	$200	$200
	Workshop	5	$20	$100
Total estimate				$38100

Recommended option to proceed

The implementation of GRASS GIS in rural regions offers a wide range of advantages, possibilities, and shared values that are well suited to the community and setting. Accepting this renewable energy option is completely consistent with the neighborhood's core values and goals for a cleaner future. The community shows its commitment to lowering its carbon footprint and actively participating in efforts to combat climate change by deliberately opting to implement environmentally friendly activities. The community has a strong feeling of shared responsibility for environmental preservation and sustainable development because of this common value.

The community will be transformed by the strategic installation of solar panels made possible by GRASS GIS optimization. The solar energy system may be effectively constructed to assure dependable energy generation even in the most remote regions by carefully studying solar radiation patterns, topography features, and other pertinent geospatial data, **(Bivand & Neteler, 2000)**. This dependability encourages energy independence and resilience, enabling the community to rely less on outside energy sources and reducing the effects of any interruptions in the energy supply. The community's resolve to determine its own energy destiny is strengthened by the feeling of empowerment it has experienced via the adoption of renewable energy alternatives.

Additionally, the initiative promotes neighborhood economic development and employment creation in addition to energy generating. The initiative becomes a driver for regional economic development since the design, installation, and maintenance of solar systems and GRASS GIS require specialized personnel, **(Sorokine, 2007)**. It also strengthens the community's commitment to the project's success by providing them with opportunity to expand their skills and capacities through training for positions in the renewable energy sector. The ensuing economic expansion and job creation inspire a sense of optimism and progress among neighbors, enabling people to actively participate in their own socioeconomic development.

This project's transformational element—access to dependable electricity— significantly enhances the socioeconomic circumstances of the neighborhood. Businesses may grow, educational possibilities can be improved, and healthcare services can be strengthened as a stable power source becomes accessible. The general well-being of citizens is elevated by improved access to electricity, notably in education and healthcare, which improves their quality of life and broadens their perspectives on the future. The project's contribution to the socioeconomic growth of the community connects strongly with its goals for development and prosperity.

Importantly, the initiative places a strong importance on participation and community interaction. Community participation in planning, site selection, and decision-making fosters a strong sense of ownership and accountability for the project's success. The inclusive approach strengthens the community's fabric and advances a common vision for a sustainable future by fostering social cohesion and togetherness. It strengthens their commitment to responsible and sustainable development and gives community members the capacity to actively shape the energy infrastructure in their area.

The GRASS GIS-enabled thorough environmental study is evidence of the community's commitment to biodiversity protection and environmental preservation. The project demonstrates a strong sense of responsibility towards safeguarding the region's distinctive ecosystems and natural resources by carefully taking environmental considerations into account in the design and installation of solar systems. The neighborhood's dedication to environmental stewardship serves as an example of responsible growth and motivates others to give biodiversity protection first priority in their plans.

The initiative enhances the community's public image by embracing cutting-edge technology and sustainable development strategies, portraying it as a forward-thinking and environmentally sensitive institution. The support of many stakeholders, including governments, non-governmental organizations (NGOs), and potential investors, is attracted by this stellar reputation. The project's success and effect have been increased by the attention and support it has received, which also strengthens its implementation and opens up possibilities for further partnerships and collaborations in the future.

Part B: Project reflection

Group Work Reflection

1. **Describe the group work strategies/processes that worked for your team.**
   Our team's ability to complete the project ahead of schedule was made possible through precise work allocation and strategic planning. We strategically divided project components, reducing the workload and maximizing efficiency, leveraging group conversations and texts for effective collaboration. Despite the project's laborious nature, we remained focused on the objective and ensured everything was on track before the submission deadline. Regularly reviewing each other's work maintained high standards and allowed for timely adjustments. Furthermore, we encouraged open communication, giving each team member a platform to express opinions and contribute ideas, fostering greater teamwork and producing innovative solutions. This inclusive environment was instrumental in successfully completing significant projects during the previous study period. Our collective dedication, united spirit, and commitment to excellence have set the stage for future achievements and reinforce the importance of collaboration in achieving outstanding results.

2. **Describe the group work strategies/processes that did not worked for your team**
   In our group, we encounter occasional challenges stemming from the uniqueness of each person's problems, making it difficult to fully grasp the topics presented by fellow members. This sometimes results in conflicts as we struggle to comprehend and provide adequate assistance. Even though the team leader has addressed the issue of timely submissions for double-checking purposes, some team members still submit their work after the deadline. As a consequence, it becomes even more challenging for the rest of the team to diagnose and support their peers effectively. To overcome these obstacles, fostering open communication and encouraging proactive collaboration could be key. Emphasizing the importance of adhering to deadlines and offering additional support and resources might help create a more harmonious and successful team dynamic.

3. **Describe what could be improved on next time you work in a group.**
   In our quest to present our project flawlessly, we recognize the significance of timely collaboration and feedback from every team member. Task assignments are meticulously noted, and we kickstart teamwork at the earliest opportunity to allow ample time for careful examination and refinement. Embracing the virtual realm of Google Meet and Zalo, we dedicate late hours, working tirelessly and supporting one another by seeking answers to every challenge that arises. Keeping track of each member's task completion and progress, along with the submission deadlines, becomes crucial to ensuring sufficient time for delivering the best possible results and enhancements to our project. We pride ourselves on the dedication we invest in nurturing a dynamic and supportive environment where every team member's contributions are valued, and together, we aim to surpass expectations and create a truly exceptional final presentation.

4. **Describe an event/action in your team that you think was outstanding with respect to each of:**
   a. Team organisation
      Binh, Nhi, Long, and Hai Anh attend each meeting in order to provide ideas and take notes on project-related material. After each lesson that is covered in class, Nhi and I will keep track of the work that has been performed to make sure nothing crucial is missed. We also feel comfortable addressing mistakes made by our coworkers and listening to one other when something is not clear. When we engage in group activities, we are also less reliant on our teammates to complete our task.
   b. Meetings
      Any team's main tactic should be communication. Everyone in my team frequent updates and communication. To provide the background material, I created a Notion group which used to notificate the tasks that must be completed and impending deadlines. To have a structured dialogue and make it happen, my coworkers set up a Discord group. group calls every Saturday and Sunday, and a Zalo group might send a message to remind individuals of their job, or the team members may send a message to request or display the finished work.
   c. Delivery of the project design ideas/budget
      The sophisticated process plans that each team member hoped to adopt are readily drawn out on paper and then successfully executed. To guarantee budgeting was nearly accurate and to ensure spending was in line with the demands of indigenous peoples so that they could pay and maintain our systems, we all had a talk about the cost and described the necessary costs. Because we are perfectionists, we must also rebuild ourselves.

d. Delivery of the Innovation concept
Mentioning the innovation concept, I'm the leader so I'll created all the concept with my idea, then we'll have a meetings to fix and contribute to the concept. Then I gave everyone their duties away and set a deadline for them to finish. There are five people in our group, and two of them will work on the same design concept while the others will do the remaining chores independently. Each criteria listed in the Innovation idea report must be included in their work.

e. Delivery of the final presentation
Everyone contributed hardly to the presentation sildes. They also working hard to be more confident on the stage also to speak frequently, their created slides are perfect and deeply explain their concept idea, budget without putting to much words.

Individual Work Reflection

Project tasks

- o Describe your tasks in the group project in each phase of the project
  - ▪ Phase 1 – Problem identification and identifying learning issue
    I joined a field trip organized by Swinburne University Vietnam for IT students in Xuan Dai, Phu Tho. In the field trip, we have experienced all the circumstances of Phu Tho communities, from worst to worstest. In that mean time, me as a leader I saw that those communities is living their lives with lack of electrictity, so a topic that related to energy is most suitable to glean information and improve their lives
  - ▪ Phase 2 – Develop design ideas using diagrammatic tools
    I found out the ideas through research an connected blue prints to understand the concept of systems. Thus, I begin using diagram creator software which is drawio, figma to detailed my ideas. Moreover, I work on research papers and reports to complete the design plan using technology applications, as well as solutions for the team's shared project goals.
  - ▪ Phase 3 – Estimation of cost (budgeting)
    To ensure that the estimate total cost for project is most effective, I have to research the websites of some companies that provide similar solutions. I use the Excel formula functions or the Internet to obtain a more precise figure, but I also need to calculate the average cost I learned about on the aforementioned sources.
  - ▪ Phase 4 – Analysing the benefits of each solution in accordance with the telecommunication guidelines
    I had to fully know both the blueprints and the concept in order to understand how they may be enhanced. I had to give the

ideas considerable consideration and adopt a broad viewpoint in order to keep track of their benefits throughout the project. The people who directly use our services and products might find them useful. Not to mention taking into account the local community's expectations, appropriateness for their needs, and, to a lesser extent, compatibility with the geographic location of the ethnic minority.

- **Contributions to the group**
  - Describe how your efforts contributed to the whole group
    . I made sure that each team member received their work in an appropriate and skill-based way by sending important alerts a few days in advance. In order to prevent us from everyone being late for submissions and resulting in unjust deductions from their grades in this course, I also put pressure on my colleagues who didn't follow the submission method by often communicating with them. Always be available to assist team members who need assistance if they are still unclear how to carry out a task effectively.
  - Describe how you were involved in the teamwork environment
    My commitment to transparent communication with my team is unwavering. I actively seek and provide explicit information to avoid any potential misunderstandings and unnecessary misconceptions during group work. This ensures that we all stay focused on our common goal, especially in this grade-critical course. Embracing a concentrated attitude is key to achieving the desired objective as a cohesive and high-performing team. By fostering open and clear communication, we can propel the group forward and maximize our collective success.
- **Conclusion and recommendation**
  - Conclude your achievement in accordance with the culturally suitable solution (you can pick either 1 or 2 solutions that suit well)
  - Recommend how you could further improve your design ideas within a team environment

Part C: Unit Learning Outcomes (ULOs)

1. Locate Indigenous knowledge systems and consider how they story the long history of technology, science, and engineering.

a. Situation: Identify and recognize the significance of Indigenous knowledge systems in the context of technology, science, and engineering.

b. Task: Research and explore various Indigenous knowledge systems to understand their historical contributions to technology, science, and engineering.

c. Action: Analyze and critically examine the ways Indigenous knowledge systems have shaped and advanced technology, science, and engineering practices over time. We made a deliberate attempt to situate Indigenous knowledge systems in the context of technology in our project. The traditional problem-solving and communication techniques utilized by the Indigenous community we were dealing with had to be researched.

d. Response: Demonstrate a comprehensive understanding of Indigenous knowledge systems and their relation to technology, science, and engineering, while ensuring the project respects and acknowledges the importance of these systems.

2. Explain the importance of, and find opportunities to, respectfully converge Western knowledge systems with Indigenous knowledge systems.

a. Situation: Recognize the need for respectful collaboration between Western and Indigenous knowledge systems.

b. Task: Brainstorm and evaluate the significance of Indigenous knowledge systems in contemporary society, emphasizing the value they bring to complement Western knowledge systems.

c. Action: Identify areas of convergence and potential opportunities for integrating Indigenous knowledge systems with Western knowledge systems. This required in-depth analysis of the communication infrastructure, user accessibility, cost, and suitability. I took a sensitive and culturally conscious approach to the project, making sure that our solutions were adapted to the unique requirements of the community.

d. Response: Articulate a compelling explanation of the importance of combining Western and Indigenous knowledge systems, while ensuring terminologies and approaches are respectful and inclusive.

3. Apply relevant knowledge of emerging technologies to a project within an Indigenous context, taking into consideration and acknowledging Indigenous histories, worldviews, standpoints, and cultures.

a. Situation: Recognize the unique context of Indigenous communities and their historical perspectives regarding emerging technologies.

b. Task: Analyze the specific challenges and needs of communication technologies and services for remote Indigenous communities.

c. Action: Explore and evaluate user access, affordability, and appropriateness of communication infrastructure in the Indigenous context.

d. Response: Apply knowledge of emerging technologies in a project that is sensitive to and incorporates Indigenous histories, worldviews, standpoints, and cultures while addressing the identified challenges and needs.

4. Function as an effective team member using project management tools and demonstrating professionalism and ethical behavior.

a. Situation: Engage in team-oriented project management activities

b. Task: Attend team meetings, facilitator meetings, and workshops to collaborate effectively

c. Action: Take an active role in planning and coordinating team activities and deliverables, ensuring timely completion of assigned tasks. I improved my understanding of new technologies by taking into account their local, international, and sustainability repercussions. In our project, we assessed several technological options while taking cultural sensitivity and sustainable development into account.

d. Response: Demonstrate professionalism, ethical behavior, and effective team collaboration throughout the project, contributing to the successful completion of team objectives.

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