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ORIGINAL RESEARCH PAPER

Multi-Criteria Decision-Making Tools for Project Selection by International Conglomerates

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Abstract
International conglomerates often take financial risks by investing funds in potential projects without conducting comprehensive assessments of the uncertainties associated with economic and political factors, which contribute to overall international business risks. In this study, an analytic hierarchy process (AHP) based approach has been developed as a practical decision-making tool for project selection in project management. The AHP enables the identification of the most valuable projects among various potential options, ensuring that investors benefit from the proposed advantages outlined in the project business plans. The capital expenditure (CAPEX), operating expenditure (OPEX), environment, social and governance (ESG) and ease of business (EOB) are the criteria selected and organised into a hierarchical framework of the AHP. The projects under each criterion are prioritised by assigning overall weights through pairwise matrix comparisons. To ensure the reliability and consistency of the pairwise comparisons, the eigenvector method is employed to evaluate the consistency of the economic freedom sub-criterion under EOB. Similarly, the AHP is applied to the CAPEX, OPEX and ESG criteria using consistent scoring and rating systems for pairwise comparisons, which enables the determination of their overall weights. Based on the analysis, the relative weightage of each decision criterion has been identified, and the score of each project has been estimated. LNG import and re-gasification terminal in Southwest India is chosen as the project with the greatest potential to fulfil the diverse requirements of the companies. Capital cost contributes the most to this decision because the projects considered in this case are highly capital intensive. At the same time, the overall scores of four projects are comparable, and thus, the final decision selection may also be based on the specific priorities of the investors.

Keywords Analytic hierarchy process · Project selection · Project portfolio management · Decision quality framework · Key value drivers

Introduction

Project selection is the process of evaluating and selecting projects that correspond with an organisation's goals which in return, improves productivity of the organisation. In the era of globalisation, the shortage of project ideas can be concluded to being non-existent. Instead, the main problem faced by many organisations is the over-generation of too many ideas. Screening of these project ideas has never been tougher than before due to the long queue of submissions waiting to be reviewed by the upper echelon of the project management team. Given the vast scope and complexity of projects, as well as resource constraints such as time and budget, finding the right combination of projects that will produce the best results is proven to be a hurdle for the project management sector. Furthermore, it is proven that selecting and pursuing a project must be done in a careful manner to avoid project failures which affect international business.

Due to the obstacle, project portfolio management (PPM), has been introduced as an integration procedure of project execution with a high-level business strategy. PPM is carried out by incorporating critical aspects such as selection and prioritisation. It has been reported that 37 percent of project failures occur due to a lack of clearly

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defined objectives and discipline when implementing strategies (EcoSys 2018). The practise of rating or evaluating projects based on a set of criteria to determine their execution sequence is known as prioritisation. Due to the interconnection between the two processes, the terms "prioritisation" and "selection" are frequently misunderstood.

When conducting project selection and prioritisation, a strong strategy has to be devised to ensure the project produces various benefits. These benefits include, but are not limited to, bigger and better return of investments (ROI), shorter time to market products, successful project deliveries and better environmental and safety performance.

The energy sector is a conglomerate of companies that produce and distribute energy. It also includes companies that explore, produce, refine, market, store and transport oil and gas, coal and other consumable fuels, according to the Global Business Classification Standard, (CFI 2021). The energy sector is extremely vulnerable to the business cycle as it is cyclical in nature. Because of the cyclical nature of the energy industry, its earnings are likewise volatile (Bertelsen and Sedlacek 2014).

The energy industry is nearing the end of its expansion cycle. The fact that the industry is dominated by a few large, well-established corporations such as ExxonMobil, Petronas, Royal Dutch Shell and BP shows that it is extremely difficult to establish a new company to rival the big-game players. However, there are new opportunities rising for the energy sector due to the emergence of new trends such as making activities such as drilling and exporting oil more expensive for corporations involved, resulting in lower long-term profitability. Secondly, the most significant new trend is the understanding of the Paris Agreement, where harmful consequences of carbon footprint are driven by the release of greenhouse gases (GHG), on our ecosystem, which is leading to a move away from fossil fuels and petroleum.

If a company were to consider about branching out into the energy and chemical industries, a general understanding on the trends provides the company insights on looking into a variety of projects throughout the world. By doing so, the company would want to invest in projects that generate the highest value. The catch to this is that if the management feels confident in its capacity to borrow money at a competitive rate, any project may be adopted and pursued by the company. Nonetheless, if the company wants to look at project investment from an opportunity standpoint, the aspects to be focused on are listed below:

1) Analyse the prospects and screen out infeasible ones in a logical fashion
2) Conduct a coarse screening on the remaining prospects and choose an end product which provides maximum value

Decision-making is a process where choices were made by identifying a decision after gathering all the necessary and relevant information, followed by detailed assessment of different alternatives. In order to assure the good quality of the decision, understanding on the requirements of a good decision is important. This can be illustrated as the decision quality (DQ) framework, which can be dissected into 6 different elements as shown in Fig. 1. This framework is applied during the decision-making of the prospects.

Developed by Thomas L. Saaty during the 1970s, the analytic hierarchy process (AHP) is a basic decision-making methodology (Saaty 1987). It is designed to handle both the rational and intuitive parts of deciding on the best option from a range of alternatives based on a set of criteria. In AHP, the decision maker makes simple pairwise comparison judgments, which are then used to create overall priorities for ranking the possibilities. The AHP allows for judgement inconsistency while also giving a mechanism to increase consistency. The AHP was created in such a way that the human mind may employ hierarchical decomposition of complex systems as a fundamental strategy for dealing with diversity. From the broad, at the top of the hierarchy, to the precise, at the bottom, the elements influencing the decision are organised in progressive degrees. The purpose of the structure is to evaluate the importance of things at one level with respect to some or all of the elements at the level above. After the structuring is complete, the AHP is fairly simple to use as a decision-making tool for various scenarios. Therefore, AHP applies vividly in the case of selecting the most economically feasible prospect, where a lot of considerations to be made during the selection process. It uses a multi-level hierarchical structure of goals, criteria, sub-criteria and alternatives as shown in Fig. 2. By conducting pairwise comparisons, the weights of importance of the decision criteria will be determined, along with the relative performance measures of alternatives in terms of each individual decision criterion (Tan et al. 2014). Along with its variants such as fuzzy AHP, these methods can also be used in making decisions on non-quantitative targets (Tan et al. 2016). In the case where the

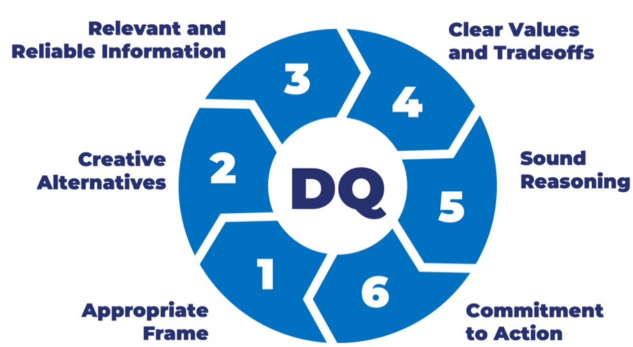

Fig. 1 Decision quality framework

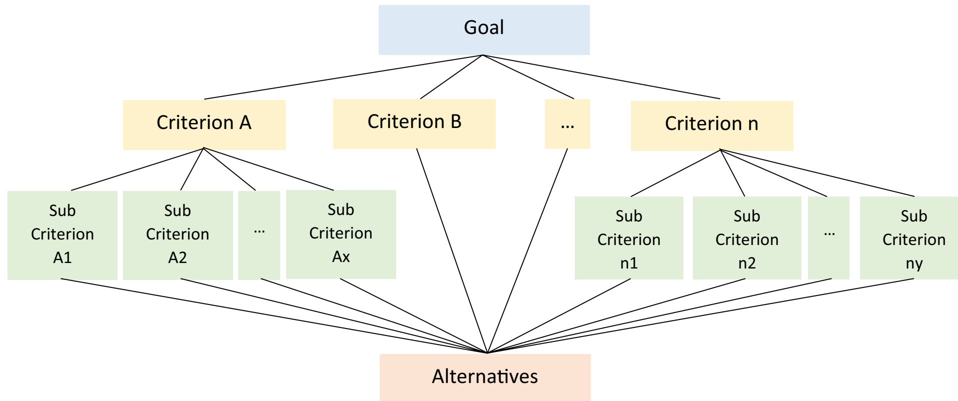

Fig. 2 Hierarchical structure of AHP

comparisons are not consistent, mechanisms for improving the consistency were introduced (Triantaphyllou and Mann 1995). AHP is widely applied in multi-criteria decision-making, resource allocation and planning as well as in resolving conflict (Saaty 1987). Some of the notable applications of these tools include the design of extraction processes (Ten et al. 2021), simultaneous consideration of process and molecular design (Ooi et al. 2018) and microalgae harvesting process (Tan et al. 2016). In an important contribution, a methodology to use AHP for project evaluation and selection has been illustrated with a proof-of-concept example (Palcic & Lalic 2009). In this work, an MS Excel-based tool has been developed for performing the analysis. In another contribution, AHP has been used as a tool for project selection by targeting sustainable development (Jurik et al. 2022). This work has highlighted the subjective nature of decision-making during project selection and proposed a more accurate approach based on AHP. Another approach has combined AHP with a linear programming model to select the among a set of construction projects (Parvaneh & El-Sayegh, 2016). This approach offers a unique combination of qualitative and quantitative approaches for project selection.

While multi-criteria decision-making tools have been extensively employed for project selection, they often lack integration with the key value drivers, especially when dealing with projects of significantly different scopes. In this work, we have developed an approach for systematically assessing the potential of various investment options in the energy sector for International Conglomerates. This methodology not only facilitates the comparison of diverse investment options but also allows for evaluations based on the specific priorities of the investing parties.

Methodology

In the early phase of concept selection, it is crucial to decide the guidelines or basis to be applied when assessing the different prospects. In this section, two main techniques, namely the decision quality and analytic hierarchy process (AHP), will be analysed for better understanding before applying during the concept selection. The decision-making process had a multi-lobed structure. It consisted of a series of workshops and brainstorming sessions whose intention was to rely on expert knowledge to identify the following items:

1. Decision parameters,
2. Risks and issues associated with individual industrial projects,
3. Success criteria specific to individual industrial projects which were selected based on the risks and issues identified in the previous step,
4. Strategy table based on decision parameters.

The DQ framework provides an easily accessible, yet general framework to conduct a decision-making process which is agnostic to the industry type. The workshops and brainstorming sessions are intended to fit the DQ framework to the specific industrial projects which form the portfolio. The AHP meanwhile acts as a tool within the DQ framework for the decision-making process.

The selection of the experts needed for the process is not covered in the paper. In general, subject matter expert (SME) level knowledge is recommended for individuals pertaining to specific components. For example, to create a "low CAPEX" strategy table for the industrial project, someone with a background in project development and/or facilities engineering and/or cost engineering is recommended. Variations might also be required for specific industries; for example, someone with expertise in ethanol manufacturing would be able to provide input for ethanol manufacturing project, wherein someone with expertise in oil and gas industry might be selected for oil and gas project. Where needed, a poll can be conducted to capture differing opinions.

The overview of the entire process selection is shown in Fig. 3, and each of these will be carried out in the following sections.

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As illustrated in Fig. 3, objectives, key value drivers, success criteria and issues were identified for each project. The objective of a project reflects what we want to achieve by the end of the project, which can be translated into deliverables, assets or other forms. Besides, key value drivers are the factors that can increase the value or worth of the project. Success criteria are the variables that measure and determine whether the outcome of a project is successful (Lamprou and Vagiona 2018). On the other hand, issues are problems that might be encountered during the execution of the project.

The next step is the concept identification and screening. In this step, each prospect needs to be screened thoroughly by conducting literature research. For each of the projects, the objectives, key value drivers, success criteria and issues were identified. Since the objective is to identify the project with the highest return on investment, the project that can achieve maximum profit with the lowest risk needs to be identified. Besides, the operation of the plant must be also safe, environmentally friendly and sustainable. Project on schedule is also crucial to ensure smooth operation without delays since delays will incur more cost and time. In the next stage, the key value drivers of the potential projects need to be identified. Some of the typical value drivers are shown in Table 1. Low capital and operating cost will help in maximising the net profit generated. With high ease of business, proven technology and high marketability of products, these will reduce the risk and ensure that our products are marketable. In addition, to govern the safety, both environmental and social, adherence to ESG and HSE is highly encouraged. Good control of the project schedule and making sure the progress is on the right track are crucial steps in project management to make sure there is no delay in the schedule of the project.

For all the prospects, there are success criteria and issues that are affecting the feasibility of each project. Therefore, before choosing any of the prospects, it is important to focus on the difficulty to decide whether mitigations can be taken to reduce the risk of issues from occurring. The typical success criteria are.

Table 1 Typical key value drivers

1. Lowest capital (CAPEX) and operating (OPEX) costs
2. High ease of business
3. Proven technology
4. High marketability of end products
5. Good control of project schedule to ensure the progress is on track
6. Adherence of environment, social and governance (ESG)
7. Adherence of health, safety and environment (HSE)

1. High income or revenue obtained
2. Continuous exploration and development
3. Improvement of technology
4. Reduction of greenhouse gas (GHG) emissions
5. Safety and environmental improvements

The first element for a good decision is setting up the appropriate frame by clearly defining the purpose of decision-making, the scope and the perspective of the decision maker(s) (Spetzler et al. 2016). A decision problem may be framed broadly or narrowly. However, for a decision with broad frame, it will consume longer time as well as have significant impact on more parties involved. For example, the stakeholders and other relevant parties will be involved when a company decides to launch a new product. With the involvement of several parties, it is crucial that the frame set is agreed by everyone.

The second element is creative alternatives, where consideration was made on different possible solutions. If there are no alternatives, no decision is required to make. Therefore, it is worth the time and effort to create and brainstorm better ideas or alternatives since DQ needs good alternatives. When various alternatives are generated, relevant information should be collected from reliable sources to make comparison between them. Relevant information includes the important details that we know, should know and would like to know about the outcomes of the decision. The information should be gathered from

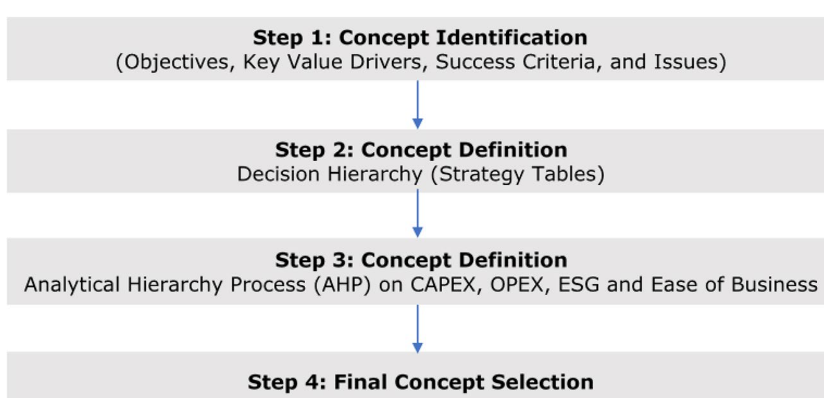

Fig. 3 Overview of project selection

reliable information to avoid biases. In addition, information collected should be associated with uncertainties, which can be either expressed as possibilities or probabilities of certain events from occurring (Spetzler et al. 2016).

Furthermore, values, which describe what we are aiming for, should be clear for every party so that a quality decision can be reached easily. However, when making a decision, it is usual to have multiple targets, such as greater shareholder value, environmental sustainability and a positive brand impact. Thus, trade-offs should be done to decide how much of one value the decision maker is willing to give up so that it is possible to get more of another. The last two elements in the DQ framework are sound reasoning and commitment to action. Sound reasoning will incorporate all the information collected and analyse in order to get the alternative which is able to deliver the most of what we want. In the case where uncertainty is crucial, tools such as tornado diagrams and decision trees can be used in this process. Lastly, commitment to action refers to the action to be taken once the decision is made so that real values can be created. Without effective action, all the time and effort in decision-making will be wasted (Spetzler et al. 2016).

To select the project from a list of promising options, analytic hierarchy process (AHP) has been applied. In this step, the decision problems are divided into three major components, namely goal, alternatives and criteria. The definition of a goal of the problem is the comprehensive objective which drives the decision problem. Next, the alternatives are referring to various choices that are being weighed in the decision. Lastly, the criteria are the factors being utilised for the evaluation of the alternatives towards the goal of the decision problem. If more differentiation is required, sub-criteria can be specified (Kluhto 2013). However, it is to be noted that not every criterion requires sub-criteria, nor do those with sub-criteria require the same number of sub-criteria.

The process of developing an AHP can be described into 5 steps:

1. The main problem is determined.
2. A decision hierarchy is structured from the top with the goal of the decision.
3. Next, the criteria and alternatives are identified and structured.
4. The pairwise comparison matrices are developed. For every criterion, a set of sub-criteria were identified and compared between one another.
5. The weightage obtained for the criteria is utilised for weighing the sub-criteria. This is repeated for each criterion and the weighing process is continued until the final score of the alternative is obtained.

In summary, the mathematical representation of AHP is as follows, a decision maker has n objectives and m alternatives. During the first stage of AHP, a weight w_i is generated for the i^{th} objective. Next, a score s_{ik} of the k^{th} alternative is given on the i^{th} objective. Lastly, the final score of the k^{th} alternative is then evaluated using the Eq. 1 below (Nguyen 2014):

$$\text{FinalScore} = \sum_{i=1}^{n} w_i s_{ik} \tag{1}$$

For the pairwise comparisons, a fundamental scale which is used in the AHP evaluation is important to indicate how many times more dominant one element is to another element with respect to the criterion on which they are compared. Table 2 depicts the fundamental scale which is utilised in the AHP for prospect selection in the latter part (Saaty 2008).

The core steps in applying AHP calculations are as follows (Nguyen 2014):

1. The pairwise comparison matrix for a decision maker with n objectives is an $n\ x\ n$ matrix $A = [\alpha_{ij}]$:

$$(a)\alpha_{ij} > 0 \text{ for} i,j = 1, \ldots, n \tag{2}$$

$$(b)\alpha_{ji} = \frac{1}{\alpha_{ij}} \text{ for} i,j = 1, \ldots, n \tag{3}$$

A matrix A which fulfils condition (a) is defined as a positive matrix whereas condition (b) as a reciprocal matrix. Besides that, Eqs. (2) and (3) also indicate that $\alpha_{ii} = 1$ for $i = 1, \ldots, n.\alpha_{ij}$ entry in A represents the importance of objective i compared to the objective j. Hence, the α_{ij} entry can be estimated in Eq. 5.

2. A consistent pairwise comparison matrix A which satisfies the conditions above is shown in Eq. 4.

$$\alpha_{ij} = \frac{w_i}{w_j} \tag{5}$$

where w_i is the weight of objective i and w_j is the weight of objective j. The above equality is true only if the decision maker is consistent.

$$(c)\alpha_{ik} = \alpha_{ij}\alpha_{jk} \text{ for} i,j = 1, \ldots, n \tag{4}$$

3. The pairwise comparison matrix A of a consistent decision maker can be summarised in Eq. 6.

$$A = \left[\alpha_{ij}\right] = \begin{bmatrix} \frac{w_1}{w_1} & \cdots & \frac{w_1}{w_n} \\ \vdots & \ddots & \vdots \\ \frac{w_n}{w_1} & \cdots & \frac{w_n}{w_n} \end{bmatrix} \tag{6}$$

where $w_i > 0$ and $\sum_{i=1}^{n} w_i = 1$.

Table 2 The fundamental scale

Intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance	Experience and judgement slightly favour one activity over another
5	Strong importance	Experience and judgement strongly favour one activity over another
7	Very strong importance	An activity is favoured very strongly over another, and its dominance demonstrated in practice
9	Extreme importance	The evidence favouring one activity over another is of the highest possible order of affirmation
2, 4, 6, 8	Intermediate value between the two adjacent judgements	When compromise is needed
Reciprocals of above	If activity *i* has one of the above non-zero numbers assigned to it when compared with activity *j*, then *j* has the reciprocal value when compared with *i*	A reasonable assumption
1.1 to 1.9	If the activities are very close	May be difficult to assign the best value but when compared with other contrasting activities the size of the small numbers would not be too noticeable, yet they can still indicate the relative importance of the activities

4. The weight vector w of a decision maker is estimated as shown in Eq. 7.

$$w = \left[w_i\right] = \begin{bmatrix} w_1 & \cdots & w_n \end{bmatrix}^T \tag{7}$$

where $w_i > 0$ and $\sum_{i=1}^{n} w_i = 1$.

The definitions 1 to 4 are then led to two important theorems in AHP.

Theorem 1: If a decision maker is consistent and has n objectives, let A be the corresponding pairwise comparison matrix, and w be the weight vector. Then, w is an eigenvector of A with corresponding eigenvalue $\lambda = n$ as shown in Eqs. 8 and 9.

$$Aw = \begin{bmatrix} \frac{w_1}{w_1} & \cdots & \frac{w_1}{w_n} \\ \vdots & \ddots & \vdots \\ \frac{w_n}{w_1} & \cdots & \frac{w_n}{w_n} \end{bmatrix} \begin{bmatrix} w_1 \\ \vdots \\ w_n \end{bmatrix} = \begin{bmatrix} \frac{w_1}{w_1} w_1 & \cdots & \frac{w_1}{w_n} w_n \\ \vdots & \ddots & \vdots \\ \frac{w_n}{w_1} w_1 & \cdots & \frac{w_n}{w_n} w_n \end{bmatrix} = \begin{bmatrix} nw_1 \\ \vdots \\ nw_n \end{bmatrix} = n \begin{bmatrix} w_1 \\ \vdots \\ w_n \end{bmatrix} = nw \tag{8}$$

$$Aw = nw \tag{9}$$

Theorem 2: The normalised form of any column of the matrix $A = \left[\frac{w_i}{w_j}\right]$ is a solution to the eigenvalue problem $Aw = nw$, where $w = \begin{bmatrix} w_1 & \cdots & w_n \end{bmatrix}^T$ is the weight vector solution and n is the number of objectives.

For inconsistent decision maker, the eigenvalue problem can be represented by Eq. 10.

$$Aw_0 = \lambda_{max} w_0 \tag{10}$$

where λ_{max} is the unique largest eigenvalue for A and w_0 is the corresponding eigenvector.

Since the decision makers do not normally make "perfect" judgement when doing the pairwise comparison, it is possible to produce a result where transitivity property is not satisfied, eventually leading to an inconsistent outcome (Alonso and Lamata, 2006). Hence, to ensure the transitivity property is always fulfilled, it is important to check the consistency of the result. To check for the consistency of the outcomes from AHP, consistency index (CI), random index (RI) and consistency ratio (CR) should be calculated. As suggested by Triantaphyllou and Mann (1995), the result is said to be consistent only if the corresponding CR value is lower than 10%, which is also in agreement with Rass et al. (2020).

Equation 11 shows the consistency index, which can be further divided into the definition for RI and CR.

$$CI = \frac{\lambda_{max} - n}{n - 1} \tag{11}$$

Random index is the average value of CI calculated from a huge set of randomly generated reciprocal matrices. With the expansion of both CR and RI, consistency ratio is

Table 3 Random consistency table

Size of matrix (n)	1	2	3	4	5	6	7	8	9	10
Random index (RI)	0	0	0.52	0.89	1.11	1.25	1.35	1.4	1.45	1.49

introduced which will indicate the consistency of the matrix as shown in Eq. 12. It is the ratio of CI (A): RI (A), where RI(A) is the random index for matrices of size n. Random index values for matrices of order 1 to 10 are presented in Table 3 (Saaty, 1987). For values higher than 10%, the comparison and ratio matrix will be revised, and re-evaluation will be done (Kluhto 2013).

$$CR = \frac{CI}{RI} \tag{12}$$

Once the relative weights are estimated, the selection of the project is done based on the total score and the individual scores which depend on the designers' choice.

Case Study

In this work, various past potential prospects in manufacturing and oil and gas exploration and development worldwide which were considered by international conglomerates were explored.

The brief description of each prospect is presented in Table 4.

If these projects are to be invested as an opportunity, it can be concluded as a short-term investment than a long-term investment. All the key value drivers mentioned in the methodology are relevant for all six potential projects.

For all the prospects, there are success criteria and issues that are affecting the feasibility of each project, which are listed in Tables 5 and 6. Therefore, before choosing any of the prospects, it is important to focus on the difficulty to decide whether mitigations can be taken to reduce the risk of issues from occurring.

To apply the decision quality framework to each project, it is necessary to list out the possible outcomes for different aspects, such as in terms of feedstock(s) and end-product(s). The detailed data listed out can be found in the Appendix. From the key value drivers mentioned in the "Methodology" section, 4 of the most important drivers shown were used to form the strategy tables by using the decision hierarchy data in the Appendix. These drivers are low capital cost, low operating cost, environmental, social and governance and ease of doing business which are presented in Tables 7, 8, 9 and 10.

For each of the strategies, the raw data in the decision hierarchy are selected in order to achieve to the respective strategy. For instance, for project 1, the mode of transportation with the lowest CAPEX is by using existing pipelines, which is the cheapest out of the options given in the decision hierarchy tables.

By applying AHP in the prospect selection in this work, the relative importance given during the pairwise comparison is determined by referring to the quantification tools available for various criteria. For example, indexes are available to compare the ease of business and political situation in various countries, which can be used to quantify these criteria, which are otherwise difficult to assess. The pairwise comparison has been performed by a team of industrial practitioners and academic researchers. Consensus on the scoring was achieved through brainstorming sessions for each pair. The hierarchical structure of this problem is presented in Fig. 4.

In order to determine the weightage of each strategy relative to each other, ratings were given as shown in Table 11. It can be seen that CAPEX is having the highest global weightage, followed by ease of business, OPEX and ESG. The outcome of this pairwise comparison is also reasonable since all these projects are CAPEX intensive, so it is crucial to consider CAPEX during the selection process. The highest weightage indicates that it is the most important strategy as it has the most significant effect on the final decision.

For CAPEX pairwise comparison between the projects, estimation of cost for each project was based on the existing plants in the country. In order to ensure reliable comparison, the estimated cost was divided by the production capacity provided. The capital cost estimated is illustrated in Table 12. With these values, it is used as the basis for pairwise comparison for low CAPEX as shown in Table 13.

Referring to Table 13, it can be observed that project 1 has the highest weightage, followed by project 4, project 3, project 2, project 5 and project 6. The reason that project 6 scores the lowest is because of its high CAPEX since refineries usually require lots of distillation columns, while for project 5, the cost of electrolyser is very high even though there are subsidies from the government. With the high CAPEX incurred, it will be very challenging to obtain a good return. For project 1, the process is mainly focusing on the purification of oil extracted, and it only requires relatively cheap equipment such as separators.

The results of pairwise comparison for other strategies, such as OPEX, ease of business, environmental, social and governance (ESG), are shown in the Appendix. As a summary, based on Table 14, project 1 to project 4 have relatively similar final weightage after comparing them in terms of strategies. On the other hand, project 6 scores the lowest as the CAPEX incurred for this project is remarkably higher than the rest. With the final weightage, the ranking of projects was done, whereby project 4 scores the first, followed by projects 1, 3, 2, 5 and 6.

Table 4 Potential prospects

Prospect	Description
Prospect 1: heavy oil development in a South American country	This prospect is based in Colombia and involves the development of heavy oil upstream process which mainly focusses on the onshore central processing facility (CPF). It requires a substantial amount of investment and additional processing for the heavy crude which further increases the cost. Nevertheless, Colombia encounters political, regulatory and unpredictable currency rate issues
Prospect 2: bioethanol development in the USA	The production of bioethanol from corn feedstock is a well-established industry in the USA, and the production process can be mainly categorised into dry milling and wet milling. The key value drivers for the bioethanol industry in the USA include government policies such as Renewable Fuel Standard Program, surging beverage production and increasing awareness to use hand sanitizer and disinfectant across the world. The tax regime is simple, and the ease of doing business is high, but there is some risk of loss of government subsidies
Prospect 3: shallow water oil field in the Caspian Sea	Caspian Sea is the world's largest inland body of water, which is boarded in the northeast by Kazakhstan, in the southeast by Turkmenistan, in the south by Iran, in the southwest by Azerbaijan and in the northwest by Russia. It is a very prolific oil field, but the oil is sour. Besides that, the facilities required for oil extraction have to be built on artificial islands which increase the capital investment
Prospect 4: LNG import and re-gasification terminal in Southwest India	The operating company is planning to build the export terminal and owns and operates the LNG barges. The operator will provide a stream of LNG at cryogenic conditions which needs to be gasified and fed to a network of pipelines to be built. It is to be noted that the region for building the pipelines has heavy population and is mountainous. The total distance of the pipelines required is 100 km
Prospect 5: hydrogen project in the Caribbean Nation	The product is green hydrogen, which is defined as production of hydrogen using renewable energy via electrolysis in Trinidad and Tobago (Rakheja 2021). The power required for the plant operation is obtained from renewable sources like solar and wind. The hydrogen will be used as a feedstock of ammonia plant. Nonetheless, the government is keen on energy transition projects and will be partially subsidising the cost of hydrogen generated
Prospect 6: a refinery in Mexico	The crude oil required as the feedstock will be imported from shale basins in the USA at a relatively low cost. The feedstock is high quality and can be utilised to convert into high-value refining products which then sell into the local market. However, the oil and gas market in Mexico is mostly held by Petróleos Mexicanos (Pemex) which is a state-owned company. It has limited experience working with international corporations

With the application of decision quality framework, decision hierarchy and AHP, it has enabled the selection of best concept. As a sequel to this study, project 4, LNG import and re-gasification terminal in Southwest India, is chosen as the final project for further study. This is also supported by the trend of LNG observed in India in the recent years, especially when India is promoting natural gas as a "transition fuel", which is also one of the commitment under the 2015 Paris Agreement to reduce the greenhouse gas (GHG) emission intensity of its gross domestic product (GDP) by 33 to 35% by 2030 (Lopes 2021). Natural gas, which is a cleaner fuel than oil and coal, plays an extremely role in transitioning from fossil fuels to other energy sources (Pospíšil et al., 2019).

Besides, as of September 2021, natural gas made up 6.5% of India's energy mix, and the share of natural gas in its energy mix is expected to be 15% by 2030. In 2020, India's government had announced the "One Nation One Gas Grid" program to expand the country's LNG infrastructure. As a result, more than 15,000 km of gas pipelines, which can cover 407 districts, is scheduled for completion by 2023 (Lopes 2021). With the positive rise in demand of natural gas as well as support from the government, project 4 has the best potential for further consideration. At the same time, projects 1, 2 and 3 also have similar scores to project 4. However, the relative weights of individual criteria are significantly different. Since the overall scores are comparable for these three

Table 5 Success criteria for each project

Project 1
1. High revenue or income generated
2. Continuous exploration and development despite of the influence from the government
3. Monetization of source of heavy oil
Project 2
1. Continuous subsidies from the government for corn-ethanol industry
2. Reduction in greenhouse gas (GHGs) emission from the process
3. Upgrade on the technology applied on the corn-ethanol production
Project 3
1. Increase in demand for global oil due to rise in energy demand
2. Good safety and environmental aspects
3. Cooperation with countries for oil development project
4. Consistent financial support from the state in terms of subsidies, legal regulations and cheap loans
5. Attract foreign investors for investing in the project
Project 4
1. Safe transportation of natural gas through the pipelines
2. Continuous supply of LNG feed from the operating company
3. Improvement in natural gas pipeline network system in the southern India
4. High production of natural gas to ensure they are adequate for the industries and residents in India
Project 5
1. Improvement in the efficiency of the electrolyser used in the process
2. Ability to meet the demand of hydrogen required in the ammonia plant
3. Proper establishment of electrolysing facilities and transportation channel of hydrogen and oxygen gas
Project 6
1. Increase in production of heavy and light crude grades due to high demand in the local market
2. Improvement and upgrading the technology and infrastructure in the existing refinery
3. Partnership with Pemex in achieving self-dependent on fuel production as well as to expand the international market
4. Increase in investors' involvement in refinery downstream industry following the energy reform introduced in 2013

projects, the investors can make the final decision based on the specific priorities.

As observed from the AHP outcome, every multi-criteria decision-making (MCDM) strategy can be used to break down complex problems into manageable components. With the use of MCDM in the AHP, several dimensions that are relevant for the decision-making context can be considered and evaluated one at a time. Using group decision-making procedures such as the pair-wise matrix comparison, the scores obtained from the various grading methods can be gathered and integrated into the final scoring system which produces a final score compromising of all existing data to aid the final decision of selecting a project. Although all projects are not the best in all categories, as long the project does not score poorly in any high-scoring criteria, it has a higher chance of being selected.

Conclusions

Project management demands various discerning talents and strategies in order to make sound conclusions in complex decision-making scenarios. The AHP is described in the paper as a decision-making process that permits several factors to be considered when undergoing the screening process implemented in the first gate of the stage gate process. To show the detailed use of AHP in project management, a detailed example of AHP on project selection was constructed. This was done to demonstrate that by considering key factors into several criteria in the AHP and analysing them accurately based on a wide range of data instead of approximations, a complex decision involving multi-criteria decision-making process can produce a clear-cut answer for decision makers instead of uncertain answers. By doing so, project management experts will be more inclined to incorporate the use of AHP as a powerful decision-making tool.

Based on the AHP study carried out, the major achievements that have made this study a success are that the overall decision-making ability from the preliminary AHP has been enhanced greatly to produce clear-cut answers. Secondly, the uncertainties present in the preliminary AHP which may hinder a decision-maker's ability to select a valuable project have been mitigated. Furthermore, the AHP can be considered to be robust as the methods and techniques used to conduct pair-wise comparisons are able to produce consistent, reliable ratings which can be trusted by future decision makers if they decide to use this tool.

Table 6 Issues for each project

Project 1
1. Huge competitions with government-supported companies (Wainberg 2009)
2. Political issues: guerrilla attacks, bombings by rebels and criminal bands (Wainberg 2009)
3. Natural disasters in Colombia: floods, landslide or earthquakes (The World Bank 2011)
4. Low heavy oil recovery rate of 10% even though efficient cyclic steam or thermal system is used (Delamaide and Parra Moreno 2015)
5. Government expressed strong intention to bet for offshore production, shown by the new model issuance of offshore contract and new discoveries in the Colombian Caribbean Sea (Strong 2018)
6. Reduction of funding from the government and setback exploration and production activities as ordered by the Council of State (Mokhatab et al. 2014)
Project 2
1. Increase in food prices, including corn which is the feedstock for bioethanol production (Snell 2021)
2. Environmental issues: water pollution due to fertiliser run-offs, greenhouse gases during the soil cultivation, fertiliser usage, irrigation, transportation and ethanol production process (Hanaki and Portugal-Pereira 2018)
3. Natural disaster: tornadoes in the USA (Boruff et al. 2003)
4. Use of corn in the production might cause famine in the country (Tenenbaum 2008)
5. Volumetric Ethanol Excise Tax Credit (VEETC) expired in December 2011, causing the prices and demand for the goods from the farmers to decrease (Diggs 2012)
6. Electric vehicles are being pushed by the Biden administration, increasing the barriers for bioethanol's marketability (Renshaw and Kelly 2021)
Project 3
1. Pollution of sea based on the past exploration methods (Cordes et al. 2016)
2. Since the oil is sour, it needs to be further processed to be sweetened and this requires state-of-the-art technology (Jayakumar et al. 2017)
3. Economic downturn in oil market and decline in oil prices (Czech and Niftiyev 2021)
4. Development of alternative and renewable energy sources which will affect the marketability of oil extracted (Aydin 2019)
5. High investment costs required to build an artificial island (Coleman 2021)
6. Outdated technology and faulty machineries in the existing oil extraction platform (Iwaszczuk et al. 2021)
7. Climate-related issues: winter climate and gradual decrease in sea levels (Molavi-Arabshahi et al. 2016)
Project 4
1. Budget and project schedule overrun (Basak et al. 2019)
2. No pipelines should be constructed within 15 m of any private dwelling (Petroleum and Natural Gas Regulatory Board 2019)
3. Safety issue: leakage of natural gas from pipelines will result in fire or explosion (Pinedale 2016)
4. Market competition with the existing LNG terminal and pipeline network projects (Kar and Vaid 2016)
5. Natural disasters in southern India: prone to flood, sea level rise and tsunami (The Associated Press 2021)
6. Environmental impact to the marine life due to the regasification process, especially for offshore regasification terminal (Mokhatab et al. 2014)
7. No plans to build pipelines through the deserts and mountains that form much of its northern borders (Zaretskaya 2020)
Project 5
1. Reliability of power supply from renewable source (Petrović, 2021)
2. Reliability of constant water supply for the operation if ocean water is used and further process is required to purify (The World Bank 2006)
3. Efficiency of electrolyser to achieve the required production rate of hydrogen (Shiva Kumar and Himabindu 2019)
Project 6
1. Changes in currency rate will possibly increase the price of feedstock crude imported from the USA (Singh et al. 2021)
2. Safety issues (e.g. explosion and fire) where the accident frequency index for Pemex increased by 100% from 2020 to 2021 (Alcalá, 2021)
3. Technological, infrastructure and expertise limitations from Pemex as well as financial issue (Oxford Business Group 2019)
4. Robberies and kidnapped of refinery workers during the government crackdown on fuel theft (Media 2020)
5. Environmental issues: high levels of methane is burning off via gas flaring and refineries are the major source of toxic air pollutants (Zavala-Araiza et al. 2021)
6. Natural disaster in Mexico: earthquake, flooding and hurricane, which pose huge risk to the safe operation of plant (Alcántara-Ayala 2009)
7. Political issues: Hydrocarbons Law was modified to give the Mexican Government powers to review and suspend existing import and distribution permits for all hydrocarbons (April 2021) (International Trade Administration 2021)

Table 7 Strategy table for low capital cost

Prospect	Feedstock	Feedstock source	Processing facility	Type of processing	End product	Mode of transportation	Marketing locations	Power source	Water source	Land area	Financing	Regulations	Technology	Air emissions	Water discharge	Political stability	Economic stability
P1	Heavy crude oil	Vertical wells	Central	Partial	Processed crude	Existing pipeline	Local	Self-generated + imported	Local	Onshore	Government investment	Moderate	Proven	High GHG	More pollutant	Low	Low
P2	Corn	Separately sourced	Near the farm "rural"	Dry milling	Bioethanol	Trucks & train	Local	Imported	Local	Farmland	Government subsidise	Easy	Proven	Low GHG	Less pollutant	High	High
P3	Unprocessed sour oil	Vertical wells	Central	Partial	Processed crude	Existing pipeline	Local	Self-generated + imported	Local	Artificial island	Government investment	Moderate	Proven	High GHG and H_2S	More pollutant	Moderate	Moderate
P4	LNG	Separately sourced	Central	Regasification	Ng	New pipeline	Local	Imported	Local	Offshore	Government investment	Moderate	Proven	Natural gas leakage	Colder water	Moderate	Moderate
P5	Water	Local water supplier	Central	Electrolysis	H_2	Existing pipeline + truck	Local	Imported solar power	Local	Land	Government subsidies	Easy	Proven	N/A	N/A	Moderate	Moderate
P6	Crude oil	Import from us	Central	Refinery	Gasoline	Existing pipeline	Local	Imported	Local	Land	Government investment	Moderate	Proven	GHG + toxic gases	Contaminated wastewater	Low	Low

Table 8 Strategy table for low operating cost

Prospect	Feedstock	Feedstock source	Processing facility	Type of processing	End product	Mode of transportation	Marketing locations	Power source	Water source	Land Area	Financing	Regulations	Technology	Air emissions	Water discharge	Political stability	Economic stability
P1	Heavy crude oil	Horizontal wells	Central	Partial	Processed crude	Existing pipeline	Local	Self-generated	Local	Onshore	Government Investment	Moderate	Proven	High GHG	More Pollutant	Low	Low
P2	Corn	Separately sourced	Industrial area	Dry milling	Bioethanol	New pipelines	Local	Self-generated + imported	Local	Farmland	Government Subsidise	Easy	Proven	Low GHG	Less Pollutant	High	High
P3	Sour Gas	Horizontal wells	Central	Partial	Processed crude	Existing pipeline	Local	Self-generated	Local	Artificial island	Government investment	Moderate	Proven	High GHG and H2S	More pollutant	Moderate	Moderate
P4	LNG	Separately sourced	Central	Regasification	NG	New pipeline	Local	Imported	Local	Offshore	Government investment	Moderate	Proven	Natural gas leakage	Colder water	Moderate	Moderate
P5	Water	Local water supplier	Central	Electrolysis	H2	Existing pipeline + truck	Local	Imported solar power	Local	Land	Government subsidies	Easy	Proven	N/A	N/A	Moderate	Moderate
P6	Crude oil	Import from the USA	Central	Refinery	Gasoline	Existing pipeline	Local	Imported	Local	Land	Government investment	Moderate	Proven	GHG + toxic gases	Contaminated wastewater	Low	Low

Table 9 Strategy table for environmental, social and governance (ESG)

Prospect	Feedstock	Feedstock source	Processing facility	Type of processing	End product	Mode of transportation	Marketing locations	Power source	Water source	Land area	Financing	Regulations	Technology	Air emissions	Water discharge	Political stability	Economic stability
P1	Natural gas	Horizontal wells	Central	Fully	Gas	Existing pipeline	Local	Self-generated	Local	Onshore	Government investment	Moderate	Proven	High GHG	More pollutant	Low	Low
P2	Corn stover	Separately sourced	Industrial area	Dry milling	Bioethanol	Trucks & train	Local	Self-generated + imported	Local	Farmland	Government subsidise	Easy	More development (corn stover)	Low GHG	Less pollutant	High	High
P3	Sour gas	Horizontal wells	Central	Fully	Gas	Existing pipeline	Local	Self-generated	Local	Artificial island	Government investment	Moderate	Proven	High GHG and H2S	More pollutant	Moderate	Moderate
P4	LNG	Separately sourced	Central	Regasification	Ng	New pipeline	Local	Imported	Local	Offshore	Government investment	Moderate	Proven	Natural gas leakage	Colder water	Moderate	Moderate
P5	Water	Local water supplier	Central	Electrolysis	H2	Existing pipeline + truck	Local	Imported solar power	Local	Land	Government subsidies	Easy	Proven	N/A	N/A	Moderate	Moderate
P6	Crude oil	Import from the USA	Central	Refinery	Gasoline	Existing pipeline	Local	Self-generated + imported	Local	Land	Government investment	Moderate	Proven	GHG + toxic gases	Contaminated wastewater	Low	Low

Table 10 Strategy table for ease of business

Prospect	Feedstock	Feedstock source	Processing facility	Type of processing	End product	Mode of transportation	Marketing locations	Power source	Water source	Land area	Financing	Regulations	Technology	Air emissions	Water discharge	Political stability	Economic stability
P1	Heavy crude oil	Horizontal wells	Central	Fully	Ngl	Existing pipeline	Local	Self-generated	Local	Onshore	Self -financed	Moderate	Proven	High GHG	More pollutant	Low	Low
P2	Corn stover	Separately sourced	Industrial area	Dry milling	Bioethanol	Trucks & train	Local	Self-generated + imported	Local	Farmland	Government subsidise	Easy	Proven	Low GHG	Less pollutant	High	High
P3	Unprocessed sour oil	Horizontal wells	Central	Fully	NGL	Existing pipeline	International	Self-generated	Local	Artificial island	Self -financed	Moderate	Proven	High GHG and H2S	More pollutant	Moderate	Moderate
P4	LNG	Separately sourced	Central	Regasification	NG	New pipeline	Local	Imported	Local	Offshore	Self -financed	Moderate	Proven	Natural gas leakage	Colder water	Moderate	Moderate
P5	Water	Local water supplier	Central	Electrolysis	H2	Existing pipeline + truck	Local	Imported solar power	Local	Land	Government subsidies	Easy	Proven	N/A	N/A	Moderate	Moderate
P6	Crude oil	Import from the USA	Central	Refinery	Petroleum	Existing pipeline	Local	Imported	Local	Land	Self -financed	Moderate	Proven	GHG + toxic gases	Contaminated wastewater	Low	Low

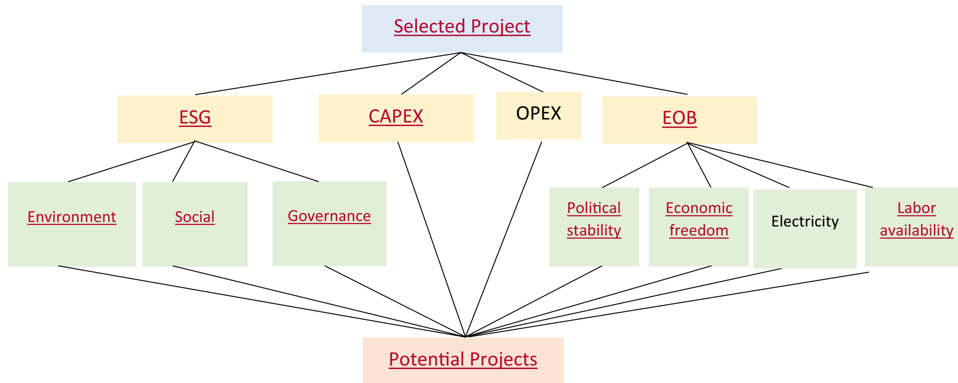

Fig. 4 Hierarchical structure of AHP with sub-criteria

Table 11 Strategy pairwise comparison

	OPEX	CAPEX	ESG	Ease of business	Weightage
OPEX	1	1/3	2	1	21.1%
CAPEX	3	1	3	1	39.5%
ESG	1/2	1/3	1	1/2	12.1%
Ease of business	1	1	2	1	27.3%
Consistency ratio					5%

Table 12 Estimated CAPEX for each project

	Production capacity (ton/yr)	CAPEX (MM USD)	CAPEX per ton (USD/tonne)	Ranking
Project 1	6,000,000	600	100	1
Project 2	300,000	200	666	4
Project 3	5,800,000	1000	172	3
Project 4	5,000000	700	140	2
Project 5	27,000	300	11,111	5
Project 6	100,000	10,000	100,000	6

Table 13 Pairwise comparison for low capital cost (CAPEX)

	Project 1	Project 2	Project 3	Project 4	Project 5	Project 6	Weightage
Project 1	1	3	2	1	5	7	30.2%
Project 2	1/3	1	1/3	1/3	4	6	13.2%
Project 3	1/2	3	1	1	4	6	22.6%
Project 4	1	3	1	1	4	6	25.2%
Project 5	1/5	1/4	1/4	1/4	1	2	5.5%
Project 6	1/7	1/6	1/6	1/6	1/2	1	3.4%
Consistency ratio							5%

Table 14 Summary of weightages for different projects

	OPEX	CAPEX	ESG	Ease of business	Final weightage	Ranking
Project 1	0.302	0.244	0.125	0.089	20.8%	2
Project 2	0.132	0.085	0.352	0.325	20.2%	4
Project 3	0.226	0.226	0.125	0.187	20.3%	3
Project 4	0.252	0.340	0.049	0.113	20.9%	1
Project 5	0.055	0.042	0.165	0.187	10.2%	5
Project 6	0.034	0.063	0.185	0.098	7.7%	6

Appendix

Table 15 Decision hierarchy for 6 prospects

Project	Feedstock	Feedstock source	Processing facility	Type of processing	End product	Mode of transportation	Marketing locations	Power source	Water source	Land area	Financing	Regulations	Technology	Air emissions	Water discharge	Political stability	Economic stability
P1	Heavy crude oil	Horizontal wells	Central	Fully	Processed crude	Existing pipeline	Local	Self-generated	Locally	Onshore	Self-financed	Moderate	Proven	High GHG	More pollutant	Low	Low
	Natural gas	Vertical wells	Distributed	Partial	Gas	New pipeline	International	Self-generated + imported		Offshore	Government investment		Proven	Low GHG	Less pollutant	High (-0.02)	High
					NGL	Trucks					International investment		More development (corn stover)		More pollutant (farm wise)		
P2	Corn	Farmland	Near the farm "rural"	Wet milling	Bioethanol	Trucks & train	Local	Self-generated + imported	Locally	Farmland	Government subsidise	Easy	Proven	High GHG	More pollutant	Moderate	Moderate
	Corn stover	Separately sourced	Industrial area	Dry milling	Co2	Co2 cylinders	International	Imported			Self-financed			High H2S			
						New pipelines					International investment		Proven	Natural gas leakage	Colder water	Moderate	Moderate
P3	Unprocessed sour oil	Horizontal wells	Central	Fully	Processed crude	Existing pipeline	Local	Self-generated	Locally	Artificial island	Self-financed	Moderate	Developing phase				
	Sour gas	Vertical wells	Distributed	Partial	Gas	New pipeline	International	Self-generated + imported			International investment		Proven	N/A	N/A	Moderate	Moderate
P4	LNG	Separately sourced	Central	Regasification	Natural gas	New pipeline					Government investment		Developing phase				
			Distributed				Local	Imported	Local	Onshore	Self-financed	Moderate	Research phase				
P5	Water	Ocean	Central	Electrolysis	H2	New pipeline + truck				Offshore	Government investment		Proven	GHG + toxic gases	Contaminated wastewater	Low	Low
	Seawater	Local water supplier	Distributed	Electrolysis + desalination	O2	Existing pipeline + truck					International investment		Developing phase				
P6	Crude oil	Import from us	Central	Refinery	Diesel	New pipeline	Local	Imported solar power	Local	Land	Government subsidies	Easy					
			Distributed		Gasoline	Existing pipeline		Imported wind power			International investment						
					Petroleum	Truck	Local	Imported	Local	Land	Self-financed	Moderate					
								Self-Generated + imported			Government investment						
											International investment						

Application of Analytic Hierarchy Process

The outcomes of AHP for different aspects, namely OPEX, ESG and ease of business are shown here.

- OPEX
  For OPEX pairwise comparison, estimation of cost for each project was based on the existing plants in the country. In order to ensure reliable comparison, the estimated cost was divided by the production capacity provided. The operating cost estimated is illustrated in Table 16. With these values, they are used as the basis for pairwise comparison for low OPEX.

Referring to Table 17, it can be observed that project 4 has the highest weightage, followed by project 1, project 3, project 2, project 6 and project 5. The reason that project 5 scores the lowest is because of its high OPEX in operating the electrolyser for the production of green hydrogen. On the other hand, project 6 is having high OPEX compared to projects 1, 2, 3 and 4 since it is a refinery industry, which is expected to have higher operating costs. The estimation of cost for project 6 is taken from the annual report from the existing refinery company in Mexico, Pemex.

- **ESG**
  For environmental, social and governance (ESG), several aspects were considered, namely the political, social stability, economic freedom and environmental performance index (EPI) ranking, as shown in Table 18. Based on Table 19, project 2 scores the highest since the USA has better ranking in economic freedom and EPI ranking compared to the remaining countries. The weightage for projects 1, 3, 5 and 6 are considered comparable as they are quite close to each other.

Ease of Business
In terms of ease of business, it is ranked based on the global ranking of the countries, which is collected from The Global Economy (2020), as can be seen in Table 20. It was believed that the higher the global ranking, the easier it was to start a business in the country. Table 21 is the summarised version of the pairwise comparison for ease of business.

Table 16 Estimated OPEX for each project

	Production capacity (ton/yr)	OPEX (MM USD)	OPEX per ton (USD/tonne)	Ranking
Project 1	6,000,000	60	10	3
Project 2	300,000	160	533	4
Project 3	5,800,000	40	7	2
Project 4	5,000,000	17	3	1
Project 5	27,000	140	5185	6
Project 6	100,000	141	1410	5

Table 17 Pairwise comparison for low operating cost (OPEX)

	Project 1	Project 2	Project 3	Project 4	Project 5	Project 6	Weightage
Project 1	1	4	1	1/2	6	5	24.4%
Project 2	1/4	1	1/4	1/5	3	2	8.5%
Project 3	1	4	1	1/2	5	4	22.6%
Project 4	2	5	2	1	5	4	34.0%
Project 5	1/6	1/3	1/5	1/5	1	1/2	4.2%
Project 6	1/5	1/2	1/4	1/4	2	1	6.3%
Consistency ratio							5%

Table 18 Political ranking, social stability, economic freedom and environmental performance index (EPI) ranking

	Political ranking	Social stability	Economic freedom ranking	EPI ranking
Project 1	148	61	49	50
Project 2	99	143	20	24
Project 3	84	129	102	69
Project 4	159	66	121	169
Project 5	149	71	38	72
Project 6	157	90	65	51

Table 19 Pairwise comparison for environmental, social and governance (ESG)

	Project 1	Project 2	Project 3	Project 4	Project 5	Project 6	Weightage
Project 1	1	1/3	1	3	1	1/2	12.5%
Project 2	3	1	3	5	3	2	35.2%
Project 3	1	1/3	1	3	1	1/2	12.5%
Project 4	1/3	1/5	1/3	1	1/3	1/4	4.9%
Project 5	1	1/3	1	3	1	2	16.5%
Project 6	2	1/2	2	4	1/2	1	18.5%
Consistency ratio							4%

Table 20 Global ranking of each project (The Global Economy, 2020)

	Global Ranking	Ranking
Project 1 (Colombia)	67	5
Project 2 (USA)	6	1
Project 3 (Azerbaijan)	34	2
Project 4 (India)	63	4
Project 5 (Trinidad and Tobago)	105	6
Project 6 (Mexico)	60	3

Table 21 Pairwise comparison for ease of business

	Project 1	Project 2	Project 3	Project 4	Project 5	Project 6	Weightage
Project 1	1	1/3	1/2	1/2	1/2	1	8.9%
Project 2	3	1	2	3	2	3	32.5%
Project 3	2	1/2	1	2	1	2	18.7%
Project 4	2	1/3	1/2	1	1/2	1	11.3%
Project 5	2	1/2	1	2	1	2	18.7%
Project 6	1	1/3	1/2	1	1/2	1	9.8%
Consistency ratio							1%

Data Availability Not available.

Code Availability Not available.

Declarations

Competing Interests The authors declare no competing interests.

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