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Evaluating Critical Success Factors for Implementing Renewable Energy Strategies in the Dominican Republic

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Abstract

Global awareness and commitment, in regards to climate change, access to water and renewable energy deployment has risen in the last decade. However, many countries are still locked in unsustainable practices, specifically in regards to energy, this results in damaging consequences not just for the country but the world. Case in point of the Dominican Republic (DR), an island with an immense renewable energy potential, a growing economy and the financial aid of many international entities. Regardless of all this, "the business as usual" decision for the energy strategies is based on fossil foil. As a result, thousands of people are still without energy, the infrastructure itself is unreliable, and the cost of fossil fuel is 8% of the country's GDP. In addition to, blackouts, the expensive tariff for users and unstable energy grid. Therefore, this paper discusses and critically evaluate critical success factors for implementing renewable energy strategies in the DR.

For this purpose, an extensive literature review was done, along with interviews with the key actors in the renewable energy market of the DR. This resulted in the evaluation of the energy infrastructure by obtaining a clear view of the situation. Future work will involve creating a framework for implementation of renewables.

Keywords: Critical success factors, Sustainable goals, successful implementation.

1. Introduction

Behavioural changes, as well as an increase in renewable energy knowledge and investment, are the key to enhancing the adoption of more sustainable practices worldwide. However, this increase is detained by unsustainable practices, especially in the energy area. As many developing countries (Low-middle economy countries) are still locked in the "business as usual" of fossil fuel for power generation; Case in point of the Dominican Republic (DR), a country with high sustainable goals yet it has locked its energy sector on fossil fuel. Despite the fact, that the fossil fuel energy generates several critical issues to the nation: Fossil fuel imports are susceptible to the unstable oil prices, and with around 85% of the energy in the country coming from Fossil fuel, this results in a high cost to the country of around 8% of the GDP, making the countries trade market unbalanced and contributing to the pollution and global climate change, which of the region the DR is the greatest CO2 polluter. In addition, the energy sector in the DR suffers from blackouts due to inadequacy of fossil fuel power generating plants and the high cost of the tariff a long with technical and non-technical issues that have plague the country for years. The paradoxical matter is that the DR has a renewable energy potential to not only supply its energy demand but to aid in supplying energy to neighbouring countries.

Some of the challenges that the DR faces are related to three specific areas: Government, Private sector and the end user. Better coordination between the involved actors would result in a successful implementation of renewable energy strategies. For this coordination and implementation, is where Critical Success Factors (CSFs) should be used.

CSFs are an x-number of the main areas where an organisation, institution, department, project and so on, must achieve an efficient performance to realise its mission, vision and goals. CSFs can be derived from a literature and organisational document review. However, Parker (2010) defines CSFs as an information analysis to a project's (Organization, Institution and more) ability to exploit its strengths and weaknesses, therefore implying an interlinking of the CSFs and the current strengths and the current barriers of the project. Also, CSFs provide a vital instrument for measuring the performance goals of a project. Also, CSFs can be obtained from the analysis of interviews with the principal management personnel about their specific position (business or project related) and the barriers encountered in reaching the goals and objectives

of the specific project, department or organisation that the interviewers belong. It is a combination of this two methods that this paper is based on. CSFs indirectly affect the renewable energy strategies, as their effect is on the asserted goals of the project and as a way to enable the success of the project mission. CSFs will also aid in increasing the efficiency of the generation, transmission, and distribution of renewable energy (RE) in the power sector of the DR. This transformation to RE must be an essential priority in the country.

In this evolving environment characterised by increasing electricity demand, the pipeline of new power generation projects is key for the sustainability of not just the country but of the world. The foremost objective of the research is to find and fill potential gaps in the existing research that might result in conclusions that will formulate an efficient CSFs and ultimately a Framework for the successful implementation of Renewables. This paper provides a summary of main energy resources in the Dominican Republic. Section three is focussed on the methodology used in this analysis. While section two will present the description of the case study of the DR with its sustainable goals and renewable energy potential. Furthermore, section four focuses on CSFs in a general manner and the un-unique and unique CSFs of the DR. Finally section five contains the conclusions that have been reached during the analysis.

2. Energy Description of the Dominican Republic

The DR is one of the largest islands in the Caribbean and possesses one of the most diverse and fastest growing economies in the region. Also, its energy consumption is increasing rapidly, at an average of one percent per year. However, the country relies heavily on fossil fuel, which needs to be imported and accounts for nearly 82% of the energy generated and supplied; at present this importation of fossil fuel represents 6% to 8% of the annual GDP (6,722.22 USD per capita) spent, this is not considering the 2% that represents the energy subsidies that the government injects into the electricity tariff to stabilised the rates for consumers (IRENA, 2016). Contradictory, the DR also has one of the highest renewable energy potential in the region (66% of energy capacity approximately 1.44 gigawatts just on on-shore wind and hydro power). However, despite all the challenges the DR has committed to several sustainable goals, as can be seen on the Table 1.

Table 1 Sustainable goals of the DR. Source: IRENA (2016).

Sl. No	Sustainable Energy Goals of the DR
1	Reduction of Greenhouse Gas emissions by 25% by 2030
2	Reduce fossil fuel import dependency
3	Reduce the local and global impacts of fossil fuel combustion on the environment
4	Increase renewable energy in the power generation mix by 25% by 2025 (Law 57-072)
5	Rural Electrification program with off-grid renewable projects
6	Blackout reduction programme

In regards, to the first sustainable goal the Dominican Republic has the highest CO2 emissions of not only the Caribbean region but of several Latin American countries. With a 0.79 gigatons per GWh in 2002 and 0.81 gigatons per GWh in 2011, having a 0.2% increase per unit of generated electricity.

The energy strategies are key for increasing the share of renewables and achieving all sustainable goals. Currently, the majority of power generation plants in the DR are primarily based on hydrocarbons, and this fossil fuel plants are very inefficient**.** On average in the DR the efficiency of fuel oil generation in 26.6% and coal steam is 28% this is extremely low and inefficient. However, the energy market is still working under the obsolete hydrocarbon laws. (Konold et al. 2015)

In recent years the sector has experienced a flourishing in renewable energy projects. However, very few of the projects are realised. In addition, the sector, and specifically the law 57-072 that rules renewable energy along with the Energy Distribution law, have gone through a series of reforms to ensure, secure and lower the cost of electricity supply to consumers, as the electricity sector is one of the highest in cost in the region, without the subsidies $1 billion USD

that the authorities of the country infuse into the tariff. These reforms have introduced some policies such as the cut to the tax incentives, which the law 57-072 initially had, by more than half, along with the feed in tariff energy method establish. These new policies have reduced the investment and interest in renewables (IRENA, 2016).

A part from the legal challenges the DR face technical and non-technical issues, especially with the grid. Some of the issues are: (a) very high distribution losses at approximately 32% in 2014. (b) Subsidise electricity prices by the government ($1 Billion USD annually), which results in an inadequate investment of funds, cutting the investment into grid capacity upgrades. This lack of grid optimisation leads to hours long blackouts. Among the non-technical challenges the major one is Electricity theft as it is not adequately addressed because of the limited regulatory capacity and implementation. Also the fear of threats from the population illegally connected. These non-technical issues account for approximately 12% of the DR electricity losses. Other technical issues are (a) inefficiencies at generation plants and substations, (b) inefficient and overloaded transmission lines. These technical and non-technical challenges contribute roughly to a loss of around $100 million USD annually (Konold *et al* 2015) in the electricity sector's creating a deficit for the country and government.

The DR possesses a strong RE potential across the wind, solar, hydro and much more. Also, this potential is spread all over the country and can meet almost completely the current power demand with the RE. In regards to local wind potential, the DR possess from 100-10000 MW with approximately 79 potential areas of high winds. In solar the DR shows incredible solar potential with a GHI that ranges from 5 to 7 kilowatt-hours per square meter per day (kWh/m2 /day) throughout most of the country and approaches eight kWh/m2 /day in some regions. The hydropower in the DR is almost at maximum capacity, as already 90% of the water sources have been utilises, meaning that any new hydropower plant would impact on a minimal scale the energy supply and demands. Also, the hydropower plants in existence only operate for short hours (4-6) a day because of water regulations that prioritise water for drinking, agriculture and then electricity. Regardless of this, the government continues to invest greatly in the area ($1.6Billion USD from 2010-2015), showing the business as usual thinking.

The Future Expansion of the electricity capacity in the DR has been planned since 2012 with the proposed addition of 2,069.5MW of energy by 2018. However of this 2,069.5MW renewable energy (RE) only represents 219MW around 10.58% of the whole energy expansion. (IRENA 2016 and Konold et al. 2015) This is an example of the unsustainable practices and thinking of the government; with the current approval and construction of the Punta Catalina Power Central that shall be coal generated, the government has efficiently locked the energy market in the DR into a fuel dependency that might probably raise the cost of electricity for consumers, and that disregards the energy goals that have been set.

The country has significant additional renewable energy potential to go beyond the projected 66%. However, for the country to reach 66% and beyond a restructuring of the current strategies is needed. The first step is to study the projects that have been implemented successfully in the DR and analyse the CSFs, to guide the country into a more sustainable future.

3. Research Methodology

Given the complexity of renewable energy (RE) issues and the paucity of comparable research in the area, a qualitative research methodology has been adopted. As Willis (2008) explains the qualitative research will aid in understanding the underlying drivers, challenges and knowledge of renewables in the DR. The data utilised in this study will be based on current scientific literature review, project documentation and interviews with the principal actors of the renewable energy in the DR; with the purpose of achieving the aims and objectives of this research. Also, a CSFs analysis has been completed. With the purpose, to identify the key areas unique and un-unique to successfully implement a renewable energy project in the DR. As Esteves (2005), Ali et al. (2008), Parker (2010) and Hsiang-Yung (2012), have described CSFs analysis can be carried out based solely on literature and documentation review or on interviews; as CSFs are a number(s) of key areas that define the performance and success of a project. For this paper literature review, documentation review and interviews are analysed and reported, to obtain a profound understanding of the current situation and challenges in the DR. It is imperative to understand the characteristics of CSFs; some of the key features are: CSF hierarchy, types, uniqueness, and stability over time. For this research, a focus on the kinds and uniqueness has been done.

The fact that the decisions for the energy infrastructure need to be decisive for a country to developed RE as this involves difficult trade offs, it was critical to gather the most current and high-quality data. As Donastorg et al. (2016) explain the use of the literature review is an essential tool for the summarising of the current knowledge by also including the analysis and synthesis of empirical cases studies. For that purpose and in-depth literature review of current research in the area has been done on the DR along with the successful implementation of renewable energy projects in the country, as to survey, synthesises and critically analyses the information. This method of collection will ensure that the scope of research will add, and not duplicate any previous research in different areas of the DR renewable energy sector and the Caribbean region. These documents were used as relevant references for the research and provided vital information about various areas of the RE situation in DR; however, a comprehensive overview of the different stakeholders, business perspective and PESTLE (Political-Economic-Social-Technological-Legal-Environmental) analysis regarding the energy strategies in the country was lacking.

Primary data was collected through Semi-structured interviews, and purposive sampling technique was used to select interviewees. This technique was chosen as the quantity of knowledgeable personnel in the area of renewable in the DR is very limited, for this very reason the identities of the interviewed has been coded as Energy interview # (EI#), to comply with the anonymity that was agreed upon, as can be seen in Table 2, along with a summarized profile of the interviewed in Table 3.

Table 2 Classification of Interviewees for CSFs for the implementation of RE projects in DR.

Participants	No. of interviwees
CEO's	7
Directors	11
Managers	7
Total	**25**

The interviews were conducted in a face-to-face format lasting for 20-160 minute. A total of 25 professionals were interviewed from the private, public and government areas of the renewable energy sector in the DR. All the interviews were transcribed verbatim.

Table 3 Description of critical criteria of interviewees.

Interviews	Detail Desired Criteria
Senior Experts Representatives	• Experience in the RE area (Technological, generation, Legal, financial, public and private sector) • Knowledge in RE subjects • At least five years of experience in RE area

For this research to make feasible proposals for assertive actions, it was imperative to understand the drivers, challenges and CSFs of all stakeholders—governmental and nongovernmental—that are critical to transforming the energy sector to RE as a reality. The semi-structured questionnaire was created, with open questions and providing the interviewer with time to explain or explore particular areas, to procure in-depth information of the drivers, challenges and knowledge from the main actors. The interviews were recorded, transcribed and supplemented with field notes as appropriate. The unit of analysis adopted for this study was the energy industry, and the embedded unit of assessment was the 'individual employee'.

Once the data was collected analysis of such data was completed. Of all the possible CSFs obtaining from the research, six essential were revealed and can be seen in section four of this paper. Once the CSFs where identity, the need to introduce them into the project hierarchy, as can be seen in Figure. 1. The purpose of CSFs is not just to be identified but to be introduced into the project and methods on how to measure them (Key Performance Indicators) created and evaluated during the life cycle of the renewable energy project.

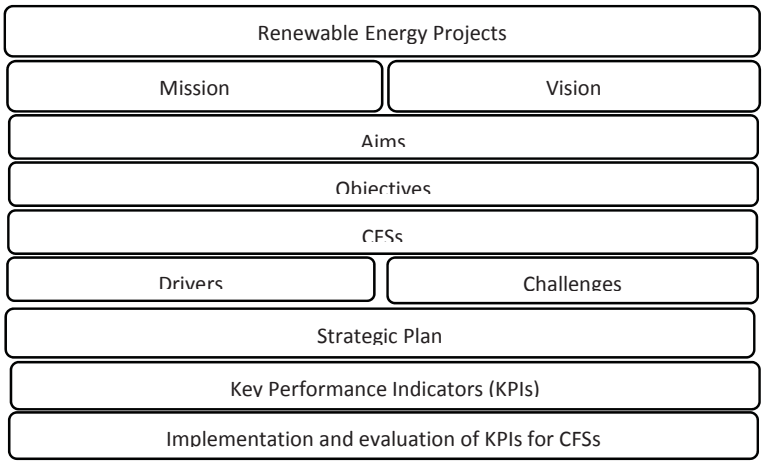

Figure 1 Renewable Energy Project Process. Source: Parmenter (2008), Esteves (2005) and Parker (2010).

The RE potential benefits, in a financial, environmental and social aspects for the DR provoke the question of why Sustainable practices, especially RE, have not become the business as usual for the country.

4. Critical Success Factors

As stated CSFs are a limited and defined a number of fields that, if implemented correctly, will ensure a successful completion of the goals and mission of the organisation or project (Parker, 2010). Many researchers (Baharuddin *et al*., 2008. Esteves, 2005., and Hsiang-Yung, 2012) defined these factors as key subjects where measures and tasks must be correctly implemented to ensure favourable results, this area is essential if the goals of the project are to be achieved. These particular areas must receive continuous and meticulous attention.

Hsiang-Yung (2012) focused the research at the renewable industry level and proposed that CSFs be common across the organisations within the energy sector. This CSFs are non-unique at an industry-level, this means that these particular factors are relevant for any company in the renewable energy project. However, Parker (2010) explains that CSFs might differ from project to project depending on the hierarchy of the CSFs. This would re-established concepts from 1979 of CSFs and would reintroduce the notions of managerial-level CSFs and organizationally unique CSFs. A thorough discussion of several researchers (Parker, 2010, Esteves, 2008 and Bahariddin et al. 2008)the tiered nature of CSFs, can be divided into four specific levels: industry, organisational, department, and individual. Now, this classification is based on the industry or environment analysed. Stainforth and Staunton (1996) restore five different levels of CSFs based on the different departments or roles in a project and how each contributes to achieving the mission of the project: (a)the structure of the specific project (industry/project CSFs) (b) competitive approach, project importance, and physical location (strategy/approach CSFs) (c) the current social-political-economical-technological-climate change environment (environmental CSFs) (d) challenges/barriers to implementing the project (temporal CSFs) leadership and knowledge management (management CSFs).

A renewable project CSFs may contain any or all of these types. Analysing and understanding the different types of CSF helps the projects professional recognise whether the CSFs are common or unique and how they may continue or evolve; no organisation can manage to create and implement a strategy that does not provide acceptable care to the primary factors which are the cause of success in the project.

As Stainforth and Staunton (1996) described the CSFs for implementing renewable technologies, however, the focus of the research, in this case, was on simply implementing the technology and did not take into account the challenges and drivers needed for the whole project. In this paper, the focus has been on the entire project and its key actors in the DR specifically, as this country is usually used as a testing ground for companies, since it is one of

the largest and fastest growing economies, investors and organizations will usually set the base of operations in the country or do a trial and error of the projects in country. The thought behind this is that if it works in the DR, it will work for the rest of the region. In this way, the DR becomes a mirror of the area.

In the case of the DR, after conducting the interview's and analysing the data the key CSFs were determined as can be seen in Table 4.

Table 4 CSFs for implementing RE business strategies in the DR.

CSFs	Percentage of interviewees Cited (N=25)	Possible Measures
Creation of financial tools for renewable energy projects	84%	Reports on: RE loans, Incentives, Cooperatives, Interest rates
Coordination between the different stakeholders	80%	Knowledge management reports and logs
Knowledge creation and exploitation related to RE business	75%	RE education and training, RE higher education curriculum
Implementation of the legal Framework	72%	Implementation committee, Surveys, incentives tracker, disclosure of incentives reports
Update and provide access to the grid	64%	Reports on rate of change of energy line connections and private connection forms
Transparency in the legal and financial tools available	60%	Reports and logs of open source publications of documentations, public auctions of agreements

5. Conclusions and Recommendations

As can be deduced from the research each CSFs augments the possibilities of success. However, this is not a 100% guarantee that the project will, in fact, succeed; as cases where some but not all of the CSFs have been present, and the project has failed, and on the contrary, others have succeeded again with some but not all of the CSFs. The important pieces of any project most be taken into account, and the more CSFs identified, and measures for them that have been correctly implemented the higher the possibility of success.

CSFs reveal areas that must be monitored over time. In the case of the DR these areas are quite broad: (a) Correct implementation of the legal Framework, as 72% of the key actors highlighted the country has sufficient laws. However, it is in the implementation of the renewable and energy legislation that the actors find insufficient. For this purpose, a re-check of the laws and how and who implements them is needed by the government in cooperation with the private sector (most affected by this CSFs) (b) Creation of financial tools for renewable energy projects. An 84% of the actors explain that the tools or funds for large renewable energy projects do not exist in the DR; 90% of the successful projects in the country have been self-financed or internationally finance (International aid organisations) (c) Coordination between the different actors. The discombobulation of the system to obtain a project and then the communication between all the players involved leaves many gaps that have been unfullfil, and that creates a state of confusion and generate a perceived risk for a renewable energy project that deters many investors and organisations to invest in renewables in the country. The same can be said of (d) Transparency in the legal and financial tools available. The interviews reveal that the lack of proper transparency in the financial instruments (banks) and on the legal aspects (PPA) creates, again, a perceived risk, that does not actually exist, but the uncertainty of the process for obtaining the project and the funds diminishes the importance and need of renewables in the country. Another of the general CSFs is (e) Update and provide access to the grid. This particular CSFs is the cost of more than 20% of a project additional or expensive cost of any project in the DR, as the lines as not suitable for renewable injection in a large scale, the owners of project

most see fit to suitable them and this presents a sure method to fail if not taken into account. This establishes that with the right legal and financial framework and technical solutions, the DR can be a key country in the region attracting significant investment in renewable energy.

Interviews and literature and document review lead to strategic conversations and to uncovering the potential success areas of future renewable energy projects for which an organisation can measure and monitor to ensure success. This CSFs, although they produce tangible results, also provide processes that help a project, institution and hopefully the country establish strong ways of thinking, communicating, and making decisions in regards to renewable energy.

The CSFs and KPIs will aid stakeholders, specially decision makers, to make the best decision to develop RE in the DR at the same time, will promote developers and investors into increasing the RE projects and economy in the country. This help will showcase to the government and the public that it is in the country's best interest to invest in RE.

Some of the areas that should be further research are the diversification of the electricity generation portfolio, wind and solar are especially feasible and should be fundamental in the country's energy mix. This diversification could be essential to reduce the country dependence on fuel imports and improve the energy supply security considering the fast-growing energy demand. The decentralisation of the grid, as currently 80-88% of the country is connected to one grid, yet the unreliability and instability of the grid still cause several blackouts and grey-outs in the country.

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The Editors

Professor Ghassan Aouad is the President of Applied Science University in Bahrain and Past President of the Chartered Institute of Building. During his research career which spans over 25 years, he successfully supervised 24 PhD students, externally examined 52 PhD students, authored 3 major research books and co-authored one book, generated more than £10M in research funding as Principal Investigator and £8M as Co-Investigator, published 92 papers in top rated refereed journals, delivered more than 50 keynote speeches and invited lectures, and presented his work in more than 42 countries. In July 2016, Professor Aouad received an Honorary Doctorate of Technology from Loughborough University in the UK.

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