A Review of the Use of SWOT analysis in Creativity and Problem Solving

Amit Kumar Gangwar, D20123666, D20123666@mytudublin.ie

Abstract—This paper looks at the use of SWOT analysis in the Problem Solving domain, it first introduces SWOT analysis technique; how it works and how to use it. Following that two papers are reviewed that use this technique. The first paper, Yasin Hajizadeh (2019), looks at the use of this technique in the context of Machine learning in oil and gas. The second paper, Teodoro Martín Noguerol, Félix Paulano-Godino, María Teresa Martín-Valdivia, Christine O. Menias, Antonio Luna (2019), looks at another use of this technique in the context of Strengths, Weaknesses, Opportunities, and Threats Analysis of Artificial Intelligence and Machine Learning Applications in Radiology. Following these papers an experiment undertaken by the author is detailed, explain the context in which it was uses, how it was used, what results were achieved, and some reflections on the process.

Index Terms— Problem Solving, Creativity, SWOT, Innovation.

I. Introduction

THIS paper looks at the SWOT analysis creativity technique, which was developed by Albert Humphrey as attributed by some authors. However, Humphrey himself did not claim the creation of SWOT, and the origins remain obscure. It was developed to address the internal and external factors affecting business while strategic planning. It works as follows:

1. Decide on the objective of your SWOT analysis.
2. Research your business, industry, and market.
3. List your business's strengths.
4. List your business's weaknesses.
5. List potential opportunities for your business.
6. List potential threats to your business.
7. Create SWOT analysis diagram/matrix.
8. Analyze and establish priorities from the SWOT.
9. Develop a strategy to address issues in the SWOT.

This technique is particularly useful for Decision making and strategic planning and is used by executives and business leaders usually.

II. Other Researchers Use of SWOT Analysis

In this section we'll review two papers who have used technique in their work and look at how they have used it and the outcomes of its use. The two papers we are going to look at are "Machine learning in oil and gas; a SWOT analysis approach" by Yasin Hajizadeh in 2019, and "Strengths, Weaknesses, Opportunities, and Threats Analysis of Artificial Intelligence and Machine Learning Applications in Radiology" by Teodoro Martín Noguerol, Félix Paulano-Godino, María Teresa Martín-Valdivia, Christine O. Menias, Antonio Luna in 2019.

A. First Paper

The first paper, Yasin Hajizadeh (2019), looks at the use of this technique in the context of Machine learning in oil and gas.

Their approach was to review some of the recent developments and practices in terms of the use of machine learning technologies in the oil and gas industry and offers SWOT analysis for strategic management and technology enablement.

Whether you are a field engineer or an executive, you must have heard of machine learning as an important technology in modern digital transformation initiatives. The motive of this study is to reduce the gap between recent advancements in ML and E&P industries. To achieve this objective successfully, this paper uses the Strengths, Weaknesses, Opportunities, Threats (SWOT) approach.

Strengths

Any ML pipeline is based on data and the oil and gas industry is fortunate enough to swim in an ocean of raw data. Furthermore, expert knowledge is available for the training of ML algorithms and domain knowledge can be used to evaluate performance and to enhance prediction accuracy.

Weakness

The oil and gas industry have a risk-averse culture and have slow technology adoption. Even in ideation and innovation projects, the Waterfall model is used. Joint Industry Projects (JIPs) are rare between competitive companies and certainly not in strategic fields like ML. A large quantity of low quality and unlabeled data is also a problem.

Opportunities

Advanced ML techniques like Hardware-accelerated ML, transfer learning, Automated ML can significantly boost performance, generate better productivity, and would facilitate dealing with the unlabeled dataset. One more absentee in the

industry is Continuous Integration/Continuous Deployment (CICD) practices in ML applications. Internet of Things (IoT) can widen the connectivity of devices and make available an enormous amount of data for predictive and prescriptive analytics.

Threats

The number one enemy of an ML success story is management's haphazard strategy. By the same token, oil price swings also have an impact on R&D spending, including analytics projects. Another barrier to the operationalization of ML is organizational resistance because of fear of losing jobs. The wide-spread adoption of ML in oil and gas also hinges on addressing safety and security concerns.

Their outcomes were that despite having adequate resources, the industry still suffers from waterfall management practices and slow adoption cycles. New advancements in ML, like transfer learning, automated ML etc., create great opportunities in this sector. The industry should also adopt agile development practices for faster growth.

Strengths	weakness
1. Amount of raw data 2. Expert knowledge	1. Technology laggard 2. Waterfall model 3. Lack of industry-wide collaborations 4. Availability of labeled and high-quality data
Opportunities	Threats
1. Hardware acceleration 2. Transfer learning 3. CICD 4. Automated ML 5. IoT and edge analytics	1. Lack of ML strategy 2. Oil price swings 3. Resistance to change. 4. Safety and security 5. Hiring and retaining ML talent 6. Technology stack

Fig. 1. SWOT Table for implementation of Machine learning in oil and gas industry.

*B. **Second Paper***

The second paper, Teodoro Martín Noguerol, Félix Paulano-Godino, María Teresa Martín-Valdivia, Christine O. Menias, Antonio Luna in (2019), looks at another use of this technique in the context of Artificial Intelligence and Machine Learning Applications in Radiology.

Their approach was to review and analyze the current status of Artificial Intelligence and particularly Machine learning in the field of radiology from SWOT (strengths, weaknesses, opportunities, and threats) analysis.

Radiology is a branch of medical science that uses medical images to treat and diagnose disease within the body of humans and animals. An image-based approach is the core of ML applied to radiology.

Strengths

AI provides tools for things like automatic lesion detection, segmentation etc. which help recognition of patterns of diseases. New imaging tools like 3-D printing may also have many potential benefits from the use of AI. In thoracic radiology, ML tools allow the larger rate of lung nodule detection and characterization with the help of CNN's using CT and X-Ray data. NLP can be used by professionals and researchers allowing integration of valuable knowledge.

Weakness

If an ML model is prepared for a task with good results, it will not be appropriate for other tasks. To build a successful ML model, quality data is required and collecting is resource, time and cost consuming. Lack of specific multidisciplinary roadmaps for ML implementation medical sector.

Opportunities

There are opportunities to use AI for radiology in the creation of new algorithms which can reduce further human intervention especially in conventional imaging tasks which are time-consuming. NLP can automate the identification of clinical terms in digital radiological reports. This can help in enriching the patient’s profile. Implementation of transfer learning algorithms may potentially reduce the need for labelled data.

Threats

AI is perceived as a black box sometimes which the cause of reluctance in its implementation by radiologist. Absence of integrated solutions to incorporate ML in their operations and lack of policies to determine which are the duties of radiologists and what are responsibilities of ML engineer.

Their outcomes concluded that AI, and in particular ML and NLP, has a wide variety of radiology applications, including CAD tools, segmentation, clustering of medical images or detection and classification of lesions. There are a few weakness and threats but there are ample strengths and opportunities to consider the implementation of AI in Radiology.

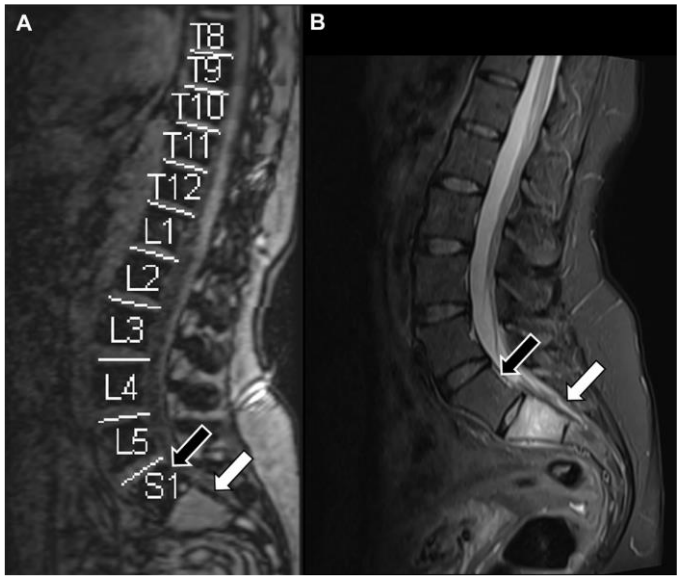

Fig. 2. Automatic identification of vertebral bodies in a patient with suspicious metastatic lesion at S2. MRI software is able to correctly number vertebral bodies (A), despite showing a clear transitional abnormality with partial lumbarization of S1 vertebral body (black arrows). A metastatic lesion at S2 (white arrows) was confirmed on sagittal fat-suppressed TSE T2-weighted sequence (B). TSE ¼ turbo spin echo.

III. My Experiment

This experiment conducts a SWOT analysis on the context of "Pursuing higher studies in Ireland".

Ireland is considered as one of the preferred destinations for higher studies by international students, especially for Master's level programme among other most preferred nations like USA, UK Australia etc. Around 14,000 international students come to Ireland every year for higher studies and most of them are from Non-EU countries. The number of international students in Ireland increased by 45% from 2013 to 2017. Particularly STEM and management programme are most preferred by international students. China, Malaysia, America, Canada, India, and Saudi Arabia were among the most common countries of origin with the highest numbers of international students coming to Ireland. Also, after Brexit, Ireland is the only English-speaking country in the EU.

Strengths

Ireland ranks among the top ten in education and provides students with one of the top education systems in the world (IMB World Competitiveness Ranking 2019), offers a wide range of graduation options, internationally recognized qualifications from world-class universities. In Ireland, international graduates have many great career opportunities because of their appeal to multinational companies, among them well-known companies like eBay, Skype and Microsoft. Ireland is also the only country that speaks English in Europe to offer international graduates a post-graduate visa to start their careers.

Weakness

When compared to other popular study destinations like USA, UK etc. Ireland has a much smaller number of universities. Also, when it comes to international ranking like QS Ranking or Times Higher Education, Irish Universities lag far behind in the list and rarely make it to even top 100. Leaving IT and Pharma sector, there are not much job opportunities in other sectors. The high cost of living in some areas like Dublin and the high-income taxes add fuel to the fire.

Opportunities

Ireland is among the countries with high minimum wages and as international students are allowed to work part-time, they could repay their education loans partially or fully just by part-time jobs. Also, there is a strong start-up culture in Ireland which can advantage for entrepreneurs. The strong presence of international communities in Ireland is also a plus point.

Threats

One year Master's/Diploma programme offered by many colleges in Ireland is sometimes not accepted in some countries/organizations like AIU (Association of Indian Universities) do not validate Master's degree of fewer than 2 years. One might also experience Visa complication while finding a job and it could be even more difficult in hard times like pandemic outbreak or recession.

Based on the SWOT analysis on pursuing higher studies in Ireland, it can be concluded that Ireland is a bright spot for higher education for international students with a lot on the positive side and least threats.

Strengths	weakness
1. High-quality education 2. Career opportunities 3. Post-study work visa opportunities 4. International students 5. Safety 6. Personal development	1. Less Number of Universities. 2. Low ranking universities 3. Less job opportunities in sectors other than (Pharma and IT) 4. High cost of living. 5. High taxes on income
Opportunities	Threats
1. Startup culture 2. High wages 3. Strong International Diaspora.	1. Visa complication while finding a job. 2. Finding job could be a difficult in hard times like Recession etc. 3. 1-year master's programme is not valid in some countries/organizations.

Fig. 3. SWOT analysis Table for "Pursuing Higher studies in Ireland".

IV. Reflections

The goal of this paper was to reflect on the use of SWOT analysis, and to explore scenarios where it can be used effectively. To this end SWOT analysis was first explained, then two papers that use it were discussed, as well as my own experiment using this technique.

My key reflections on this technique are as follows:

- It's a high utility technique which allows us to analyze both internal (strengths and weakness) and external (Opportunities and Threats) factors before decision making.
- It's a simple to implement technique.
- The out of the analysis can be accommodated to a SWOT table which is easy to read and understand.
- Though it is popular among business community, it can be easily applied in any kind of scenario.
- In pre-crisis planning and preventive crisis management, SWOT analysis can also be used.

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