SMART decision analysis for choosing optimum business intelligence tool for SMEs

Ahmed, Md Shakil; Gilardi, Marco; Dahal, Keshav

Published in:
Proceedings of the British Academy of Management 2021 Conference

Accepted/In press: 30/05/2021

Document Version
Peer reviewed version

SMART Decision Analysis for Choosing Optimum Business Intelligence Tool for SMEs

Abstract
In today's business environment, choosing the required business intelligence (BI) tools are important to support SMEs recovery. The COVID-19 pandemic has changed businesses to focus on better digitization, not only in their day-to-day business activities, but also in effective use of BI tools for decision making that account for the changes in the business environment. For SMEs' recovery, it is important that a certain amount of budget is dedicated to afford information technology innovation that supports growth. In this paper, we propose a strategy based on the simple multi-attribute rating technique (SMART) to help directors and managers of SMEs for selecting the optimum business intelligence tool.

Keywords: business intelligence, small and medium enterprises (SMEs), simple multi-attribute rating technique (SMART), decision making

1. Introduction

Decision making in business is a daily activity that ranges from fixing a new price for a manufactured item and determining a market strategy to choosing a software system depending on various attributes. For the business to succeed it is important to make appropriate and effective decisions or the penalty for mistakes might be expensive with respect to cost and time. Whether a decision taken is good or bad, it is not evident at the time of decision making, but rather it becomes apparent later when we see the implications of that decision on the business (Buede 2016). Decision makers need to consider a wide range of alternatives that are enriched with essential and desirable criteria and follow an analytical approach to make a final decision (Goodwin and Wright 2014). According to (Keeney 1982), some characteristics of decision problems are: high stakes (i.e., the perceived desirability in alternatives differ much), complicated structure (i.e., difficult to appraise the alternatives as there are varied features in alternatives), absence of overall experts (i.e., all are not experts in all subject maters), requirement to justify the decisions (i.e., justification is important to convince the stakeholders). It is therefore necessary to follow a systematic approach to effective decision making that is fruitful and produces the desired result.

One of the popular methods of decision analysis supporting the decision maker (DM), who has multiple objectives, is known as 'simple multi-attribute rating technique (SMART)' (Edwards 1977). In the SMART method, various attributes identified by the DM for the solution are ranked on their relative importance in descending order. That means, attributes whose orders of magnitude are greater than peers tend to dominate the outcome in decision making (Taylor Jr and Love 2014). In this paper, we contribute with an analysis of the simple multi-attribute rating technique (SMART) and adapt it to the case of choosing the optimum business intelligence tool for SMEs. SMEs can easily implement this decision-making process even though they have the constraints in expert knowledge on modern digital solutions. There is considerable research on entrepreneurial decision-making processes, see Shepherd et al. (2015), however, there is limited research on decision making strategies targeted to SMEs (Laurinkevičiūtė and Stasiškienė 2011, Salles 2006). This paper contributes by discussing a novel application of the SMART technique that benefits the upper echelon of SMEs during the decision making process of selecting an appropriate technology that fits their purposes and helps them improve business performance. In this paper we demonstrate the application of the SMART model to the problem of choosing a BI software tool with reference to the case study of a chocolate company that underwent such decision during the COVID-19 pandemic.

2. Related Works

The SMART technique of decision making was introduced in 1971 by Ward Edwards' works which was extensively utilised because of its simplicity and went through a series of improvements (Edwards and Barron 1994). This decision-making technique involves multiple objectives or criteria with a given set of alternatives. The performance of each alternative is calculated in grades on numerical scales evaluated through direct-rating methods (Makowski, 2001:3). SMEs need to take important decisions for their day-to-day business initiatives. In selecting the suitable software tools sometimes, they take the decision based on the available data and quotes from different vendors. However, for choosing the business intelligence tools it requires a thorough analysis because, some BI tools are for the corporate use which might not be suitable for SMEs. So far BI was the privilege for large companies who could afford a team of IT support specialists and data scientists. But now-a-days, the BI tools have become lightweight, affordable, and accessible. These self-service tools can provide informed decisions from data. But it is important to select the suitable BI tool for the activities of SMEs specially to support their recovery from the adverse effect due to COVID-19 pandemic. The SMART technique could help the SMEs to make this decision of choosing the preferred BI tools from a varied number of alternatives which will be further illustrated in the following sections.

According to Howard (1988), decision analysis is a systematic approach towards transforming an opaque decision problem to a transparent one by following some transparent steps. Howard (1998) further clarifies that decision analysis helps a decision maker with clear insight to avoid confusion and attain a desired action. Through the process of decision analysis managers can use their time efficiently to clarify their thinking. It also helps documenting the choice made enhancing communications with the team members involved in the decision making (Goodwin and Wright 2014, Rouwette et al 2016). This echoes with the suggestion of Phillips (2005) that decision analysis is a process that helps with insights for making an effective decision for an organization. According to Howard (1988), the first step for decision analysis is the real decision problem which is not yet clear (opaque). The decision maker will formulate some logic (computational process) in line with the decision basis with alternative options to choose from, which will be further evaluated in the next stage. At this following stage, further analysis will guide the decision maker to come to an appraisal that the alternative option recommended is persuasive and applicable for the person to act and follow in the real time. This appraisal stage can even show some shortcomings which can be refined further by feeding back to the formulation stage.

Parnell et al. (2013) argues that there are nine decision making soft skills: strategic thinking, conducting surveys, leading decision analysis team, managing decision analysis projects, aggregating across experts, researching, interviewing individuals, facilitating groups, and communicating expert insights.

As mentioned at the beginning to this section, we can reiterate that SMART method is a method of multi-attribute decision making technique which is used to support the decision makers to choose one option out of a good number of alternatives. However, this is not going to affect other attributes if there are reduction or addition of them (Taylor Jr and Love 2014, Amato et al 2013). This method of decision making is widely used because of its simplicity (Kahraman 2008) and applied in different fields such as for deploying renewable energy deployment decisions, for designing multi-criteria performance measurement framework, consumer surveys (Taylor Jr and Love 2014, Kasie, F. M. 2013, Rahadjeng, I. R. 2020) etc. But using the same technique in choosing the BI tools from a good number of alternatives for SMEs is discussed here. This is important for SMEs due to their lack of expert IT knowledge and desperate need to overcome the post COVID-19 effects on the business.

3. Context and Outlining the Decision Problem

A Scottish chocolate company with about 200 employees has an existing integrated software system based on Microsoft Dynamix AX that supports its order processing system, which is in operation since 2017. The company is interested to procure or develop a business intelligence (BI) tool which will help to predict variables such as seasonal sales, performance of the sales-reps, stock positions, geographical sales data etc. To achieve this capability the company has two choices, either procure a third-party BI tool from a list of vendors or developing the in-house tool to meet the purpose. The company initially considered in-house development of a bespoke BI tool. However, the idea was discarded because this route would require a long time for development and integration (estimated 1 year), which was not an affordable choice due to the need for the company to react to the pandemic effectively and quickly. Moreover, in house development would be an expensive solution for the company, which would require to hire a programmer as the company does not have an IT infrastructure supported by an IT department.

Based on these motivations the choice of adopting a third-party tool was made. Initial characteristics of choosing a BI tool would be as follows:

a. Quick integration (1 - 3 months).
b. Fulfil a specific list of required features.
c. Cost-effective solution.

The cost involved for these alternate options are shown in the following Table-1. At the left column of the table, different BI software is anonymised as A, B, C and D. E is the option for choosing the in-house development. In the next section, the trade-off for the costs against the attributes/benefits for these alternatives will be judged and analysed. However, the costs will not be considered for the initial analysis using the attributes such as: Complicacy, Add features, Timeframe, User friendly, Training etc. In section 4, the trade off with the cost for final decision making will be accomplished.

Table-1: Alternate Options

Alternatives	**Yearly Cost Involved**
A	£4,000
B	£3000
C	£2500
D	£2000
E (In-house Development)	£12, 000

The value tree is shown in Fig. 1:

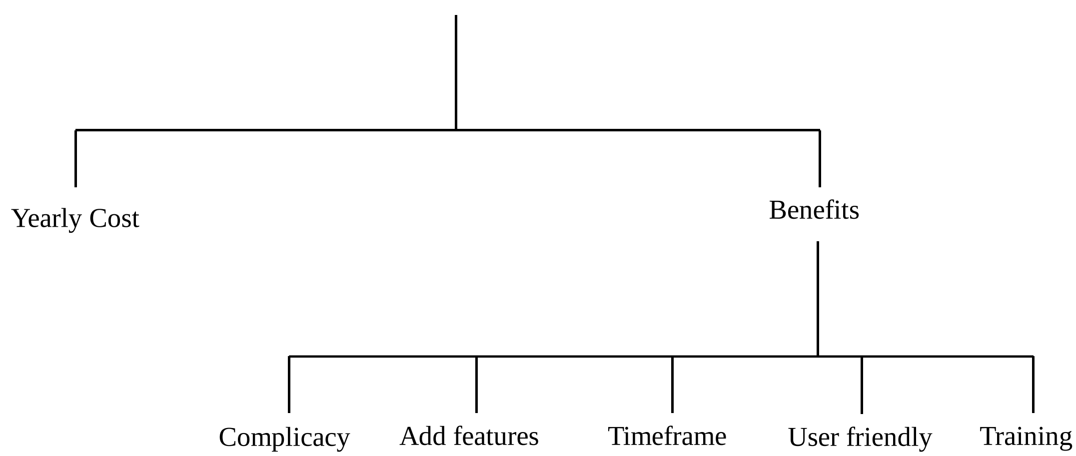

Fig. 1: Value tree for choosing the BI tool for the case study of SME.

The yearly cost involved for the In-house Development of BI tool is expensive compared to the other options and maintaining the system in the long run would be difficult for SMEs without in house IT departments. The other options have varied types of features which are user-friendly and attractive if chosen with desirable options fulfilling the company's basic requirements first.

Based on the options highlighted above, company directors need to take a decision to choose a viable option for BI software adoption which will be discussed in more detail in the following sections.

4. Application of SMART to the Outlined Decision Problem

The SMART technique of decision making has been used widely for its transparency and it is adopted by people with different backgrounds. Despite its wide adoption, this technique might not be able to capture all the complexities for a decision making, even though this is useful for revealing the important dimensions of the problem and their relative weightage (Goodwin and Wright 2014). To ensure that the aforementioned complexities are captured we propose that decision makers adhere to the following stages:

Stage-1: The operations director of the company takes an individual assessment about this future BI system to choose for the benefit of the company.

Stage-2: The alternative courses of action i.e., choosing the different software including the in-house BI development options are considered and tabulated as shown in Table-2.

Table-2: Alternative Courses of Actions

Attributes	A	B	C	D	E
Complicacy	medium	easy	medium	medium	difficult
Add features	yes	yes	yes	no	yes
Timeframe	1 month	2 months	2.5 months	3 months	1 year
User friendly	yes	yes	yes	yes	no
Training	short training	short training	short training	short training	long training

Stage-3: The attributes are shown as the left-most column of Table-2. These attributes differentiating the BI tools will be the factors such as complicacy, adding features, timeframe, user friendliness and training.

Table-3: Value of attributes

No	Attributes	Not Acceptable	Bad	Good	Better	Very Good	Excellent
1	Complicacy (Score)	Very Complicated (0.0)	Complicated (10.0)	Nor Very Complicated (40.0)	Easy (45.0)	Very Easy (50.0)	Quite Easy (80.0)
2	Add features (Score)	< 3 (0.0)	> 3 < 5 (60.0)	> 5 < 7 (70.0)	> 7 < 9 (75.0)	> 9 < 12 (80.0)	< 12 (100.0)

3	Timeframe (Score)	> 1 Year (0.0)	= 1 Year (10.0)	> 2.5 Months < 6 Months (50.0)	> 2 Months < 3 Months (60.0)	= 2 Months (70.0)	= 1 Months (100.0)
4	User friendly (Score)	Not at all User Friendly (0.0)	Somewhat User Friendly (50.0)	User Friendly (70.0)	Better User Friendly (75.0)	Very User Friendly (80.0)	Quite User Friendly (90.0)
5	Training (Score)	No Training Support (0.0)	Minimum Training Support (20.0)	Good Training Support (25.0)	Better Training Support (30.0)	Very Good Training Support (35.0)	Excellent Good Training Support (80.0)

Stage-4: Assign the values for each attribute (Table-3). For each attribute, different values are assigned to measure the performances of each BI tool. How these values are calculated are mentioned in Table-3.

The values for each BI tool are also related to the attributes mentioned in Table-2. From the data available from the websites for different BI software, relative values of the attributes were determined one by one. First the attribute 'Timeframe' was chosen to determine its respective values for different BI tools. Some preliminary information was also obtained from Table-2 such as the durations for their implementation. Based on this information, further precision is made to get the comparative values. For example, timeframe for the implementation of tool 'A' was 1 month which is the shortest time compared to that of the In-house Development one which would take about 1 year to develop. As such, its value (Option-E) is given arbitrarily as 10. Depending on the comparative duration of implementation for other BI tools, we have determined their respective values for the 'Timeframe' attribute. Next, the attribute 'Complicacy' was chosen to determine its respective values for different BI tools. Here also, some preliminary information obtained from Table-2 was catered for. Based on this information, further precision was made to get the comparative values. For example, complicacy for the implementation of BI tool using In-house Development was difficult as such its chosen value was 10.

Table-4: Weights of attributes

No	**Attributes**	**Normalized Weight**	**BI Tools**				
			A	**B**	**C**	**D**	**E**
1	Complicacy	30	50	80	40	45	10
2	Add features	23	80	75	70	0	60
3	Timeframe	20	100	70	60	50	10
4	User friendly	15	90	80	75	70	0
5	Training	12	30	25	35	20	80
Total		100					

From the demonstration of the tool 'B' from the website, it was found to be quite easy to use and was given the value of 80. Depending on the comparative complicacy for the BI tool's usage and getting the characteristics from the websites their respective values for the 'Complicacy' attribute for other tools were determined. Basing on this similar procedure of assigning respective values for attributes 'Add features', 'User friendly' and 'Training' the data were calculated and shown in Table-4.

Stage-5: The normalized weights for each attribute is calculated and shown in Table-4 (3rd column). Here, the weights are determined with comparative importance of the attributes. The Complicacy attribute is found to have higher weightage than the others. After determining these weights, the normalized weights for these attributes were calculated so that they add up to 100.

Stage-6: At this stage, the sum of (Value × Weight) for all the attributes for each BI tool is calculated. Then the aggregate value is found by dividing the respective sums by 100. This will give the highest value of 70.50 for tool 'A' as shown in Table-5.

Table-5: Aggregate benefits

Alternatives	**Sum (Value × Weight)**	**Aggregate Value**
A	7050	70.50
B	7025	70.25
C	5555	55.55
D	3640	36.40
E	1880	18.80

Now to trade-off between cost and benefit, a graph is drawn showing the aggregate value for different BI tools in the Y-axis and Annual Cost (£) in the X-axis (Fig. 2).

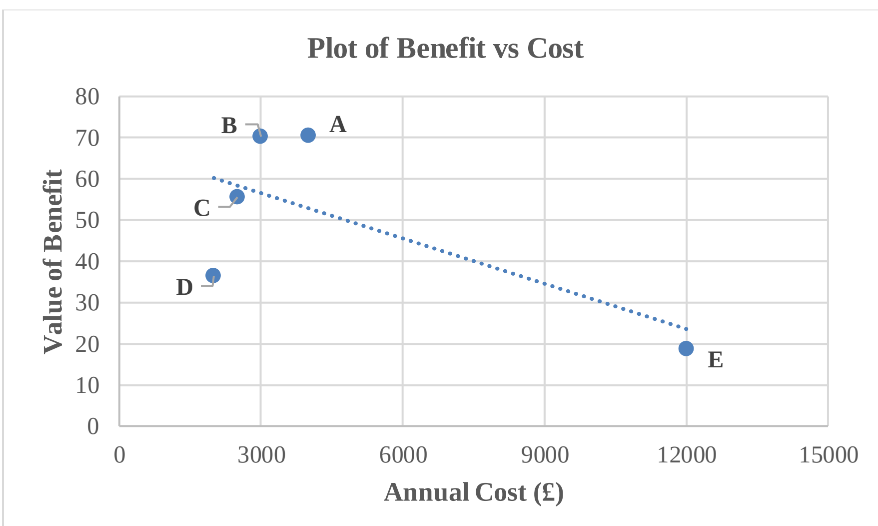

Fig. 2: Plot of Benefit vs Cost

Stage-7: From Table-5 it is seen that BI tool 'A' has greater benefit (70.50) compared to that one of 'B' (70.25). However, if the Values of Benefit vs Annual Cost (£) as mentioned in Fig. 2 are plotted, it can be seen that tool 'A' is costly for getting a meagre benefit difference of 0.25. As such, choosing 'B' as a BI tool would be preferable for the organization.

Stage-8: At this stage, sensitivity analysis (Goodwin and Wright 2014) is carried out to see the robustness of the decision with respect to the changes in figures given by the DM. It is also pointed out here that this type of analysis helps the DM to see the changing effects with respect to one weight at a go. This analysis also helps to see combinedly the sensitivity of aggregate scores of alternate options with respect to the simultaneous changes in weights and values crosswise the ranges (Goodwin and Wright 2014).

6. Conclusions

In the SMART analysis as demonstrated above, the five attributes chosen for taking a decision on selecting the best option for BI tool was related to the important functions of a generic BI tool for a sales organization located in Scotland. It was found that this analytical tool of decision making to be very simple and effective. To obtain the decision making as intelligent as possible, it is wise to have the decision makers sitting together who have quality information about the varied alternatives, uncertainties, and preferences. In practice, these information are not of good quality as preferred by the decision-making organization (Parnell et al 2013). There is a description regarding the behavioural decision insights and barrier to good decision making in Decision Traps as mentioned in (Schoemaker and Russo 1989). In this SMART analysis, the additive model was used which might not be suitable for all the cases as because this model is not proper where there are interactions in between the associated values of some attributes (Goodwin and Wright 2014). In selecting the BI tool, 'Add features' and 'User friendly' might complement to each other where the combined values will approach to a greater value than the sum of individual values. There might be some problems in this SMART analysis in defining the weights for different attributes because of choosing the range in between the most preferred option and the least one for each of them as further explained in an example in (von Winterfeldt and Edwards 1986).

References:

Amato, F., Casola, V., Esposito, M., Mazzeo, A. and Mazzocca, N. (2013) *A smart decision support systems based on a fast classifier and a semantic post reasoner*. International Journal of System of Systems Engineering, 4(3-4), 317-336.

Buede, D. M. (2016) *Decision Making and Decision Analysis,* [Online] Available at: https://link.springer.com/referenceworkentry/10.1007/978-1-4419-1153-7_217#howtocite (Accessed: 30 Dec 2020).

Kahraman, C. (2008) *Multi-criteria decision making methods and fuzzy sets. In Fuzzy multi-criteria decision making* (pp. 1-18). Springer, Boston, MA.

Kasie, F. M. (2013) *Combining simple multiple attribute rating technique and analytical hierarchy process for designing multi-criteria performance measurement framework*. Global Journal of Research In Engineering.

Keeney, R.L. (1982) *Decision analysis: an overview*. Operations Research, 30, 803−838.

Goodwin, P. and Wright, G. (2014) *Decision analysis for management judgment. John Wiley & Sons.*

Howard, R.A. (1988) *Decision analysis: practice and promise*. Management Science, 34(6), 679−695.

Laurinkevičiūtė, A., and Stasiškienė, Ž. (2011) *SMS for decision making of SMEs. Clean Technologies and Environmental Policy*, 13(6), 797-807.

Phillips, L.D. (2005) *Decision analysis in 2005*. In A. Robinson & J. Parkin (eds.), OR47 Keynotes/Tutorials, pp. 115–132. Birmingham: Operational Research Society.

Parnell, G.S., Terry Bresnick, M.B.A., Tani, S.N. and Johnson, E.R. (2013) *Handbook of decision analysis (Vol. 6)*. John Wiley & Sons.

Rahadjeng, I. R. (2020) *Application of the Simple Multi Attribute Rating Technique (SMART) Method on the Selection of Anti Mosquito Lotion based on the Consumer*. IJISTECH (International Journal of Information System & Technology), 3(2), 152-158.

Edwards, W. (1977) *How to use multiattribute utility measurement for social decision making*. IEEE transactions on systems, man, and cybernetics, 7(5), pp.326-340.

Edwards, W. and Barrons, F. H. (1994) *SMARTS and SMARTER: Improved Simple Methods for Multiattribute Utility Measurement*. Organizational Behavior and Human Decision Processes, 60, pp. 306-325.

Taylor Jr, J.M. and Love, B.N. (2014) *Simple multi-attribute rating technique for renewable energy deployment decisions (SMART REDD).* The Journal of Defense Modeling and Simulation, 11(3), pp.227-232.

Salles, M. (2006) *Decision making in SMEs and information requirements for competitive intelligence. Production Planning & Control*. 17(3), 229-237.

Schoemaker, J.E. and Russo, P. (1989) *Decision Traps*. New York: Bantam/Doubleday/Dell Publishing Group.

Shepherd, D. A., Williams, T. A. and Patzelt, H. (2015) *Thinking about entrepreneurial decision making: Review and research agenda*. Journal of management, 41(1), 11-46.

von Winterfeldt, D. and Edwards, W. (1986) *Decision Analysis and Behavioral Research*. Cambridge University Press, Cambridge.