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"A MCDA-based Approach on Corporate Investment Decision Process: A case study of a Small-sized Firm's decision on Foreign Direct Investment"

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Abstract

Small and medium-sized enterprises have frequently been facing great troubles in capital budgeting and investment decisions. Part of these hurdles comes from the very nature of the modern financial decision problems. While well-known classic optimization methods can properly solve traditional financial decision problems with a single objective, they fail at solving real-world complex problems, which involves the interplay of multiple concurrent decision factors, against a backdrop of financial constraints. As a result, the corporate finance field has been demanding more sophisticated approaches, which integrate traditional quantitative methods with Multi-Criteria Decision Analysis techniques (MCDA), probabilistic models, simulations and optimization methods. This paper combines Corporate Finance theory with a MCDA approach based on the von Neumann-Morgenstern's Utility Theory and presents a case study within a small-sized firm that needs to decide whether or not to expand into international operations, given a set of decision factors and financing constraints. The results deliver a structured decision framework to assist the firm's managers, increasing impartiality in the investment decision process and help the decision makers (DM) reach a rightful, well-substantiated decision to their investment decision problem.

Keywords: *Corporate Finance Decision Problem; Investment Decision; MCDA; Financial Modelling*

I. Introduction

The level of uncertainty to which decision makers (DM) from the corporate finance domain have been subjected, has never been so high as in the past decades. The increasing complexity in financial models has been pushing corporate leaders to non-trivial decision problems. Corporate managers often face troubles in making effective investment decisions, given the multiple scenarios, conflicting objectives and various criteria that a single decision event usually poses.

Part of these troubles comes from the very nature of the modern financial decision problems, which are often comprised of multiple objectives and whose possible solutions must presumably satisfy a broader set of stakeholders. Modern corporate managers have to deal with decision events that involve not only the need of robust risk management instruments, but also to handle the interplay of a complex set of strategic objectives that frequently compete to each other, against a backdrop of financial constraints and resource limitations.

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Moreover, corporate decision makers tend to overestimate their personal ability in deciding how and where to best invest company's earnings and may neglect some strategic factors in their decisions. Studies from Tang & Leung (2005) indicate that the more a firm's investment decision process foregoes a structured decision framework, the higher the chance of a mistaken decision is made, which may lead from mild economic losses to the company to severe financial damages to the firm's shareholder.

As a result, the corporate finance field has been demanding more sophisticated approaches, which integrate traditional quantitative methods with multi-criteria decision analysis techniques (MCDA), probabilistic models, simulations and optimization methods (Hallerbach & Spronk, 2002; Zopounidis & Doumpos, 2002).

In this context, this paper presents a case study, in which we implement a Multicriteria Decision Analysis technique (MCDA) to assist a group of managers in a real-world capital investment decision problem faced by their firm. The case study is based on a Brazilian small-sized enterprise (SME), that operates in the textile sector.

The firm's managers must decide whether to invest in an internationalization project through the creation of a new maternity bag manufacturing facility in Paraguay or to allocate the firm's capital in a new factory located in Brazilian territory.The decision towards investing in a foreign or a domestic location is based on a particular set of preferences displayed by DMs against a certain level of capital available for investment. Alternatively, investing in a new manufacturing plant in domestic territory represents less uncertainty, but also less expectations on the return of the invested capital.

This decision is far from trivial, particularly for SMEs: Limited access to professional consultancy services with advisory capacity and constrained financial resources have left many SMEs adrift while assessing their strategic alternatives to enter international markets. While large enterprises can resort to large amounts of capital, human resources and strategic information as to foreign markets, international policies and structured business models (Cavusgil, 1980), small firms frequently lack a framework that supports and validates such decisions. As a result, a great number of small firms fail at attempting to establish operations in foreign markets (Felzensztein et al., 2019).

The point of time when firms have to decide whether or not to grow internationally depends on several aspects, such as firm's operational maturity, financial situation, market saturation, competitive landscape and countrywide economic reality. Small and medium-sized enterprises, initially designed to operatewithin their domestic markets, at some point of their growth process, might have to decide whether to expand into foreign markets or to remain local (Luo & Zhang, 2016). In many cases, this decision is so critically important to small-sized enterprises (SME), that an erroneous decision can ruin the entire operation (Almeida-Filho et al., 2021).

In order to model the investment decision problem of our case study, we apply MAVT (Multi-Attribute Value Theory), based on von Neumann-Morgenstern's Utility Theory. The MCDA techniques allow complex decision problems to be broken down into smaller and more digestible problems (Goodwin & Wright, 2004) and then separately handled and finally reassembled in a complete picture, so that a course of action can be chosen (Løken, 2007), given a set of preferences, objectives, risk appetite and constraints appraised by the company's managers.

Furthermore, this work combines Corporate Finance theory with Firms Internationalization's theory and deployment of MCDA techniques in a practical perspective as an attempt to assist corporate managers to reach right, well-substantiated decisions as to whether or not to invest in international operations.

The rest of this paper is organized as follows: Section II presents the theoretical background on MCDA methodsfor decision problems and the general theory on internationalization of small firms. Section III outlines the methodology adopted for the research; Section IV presents the findings the case study with respective interpretations. Section V encloses general discussions about our findings and Section VI concludes the paper with limitations found during the work as well as avenues for future research.

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II. Theoretical Background

Multi-criteria decision analysis techniques are commonly referred as to a general methodology comprised of a set of well-structured methods used support DMs in decision problems with conflicting criteria (Bogetoft&Pruzan, 1991). Although a MCDA method is not meant to deliver optimal decision by itself, it helps the DMs have a deeper and broader understanding of the problem, its possible solutions and trade-offs.

Multi-Criteria Decision Analysis offers a large spectrum of methods and techniques for a wide range of applications. Different types of decision problems may require different MCDA methods, depending on the nature of the problem and how the problem is structured (Franco & Montibeller, 2011).

The usage of MCDA in the domain of finance decision problems is not new. It gained higher academic attention in the 1980s as an alternative to solve multidimensional financial decision problems, involving the existence of multiple decision criteria in an ill-structured evaluation process (Roy, 1988). While traditional financial decision problems involving a single objective and restriction can be properly solved with well-known classic optimization methods, they fail at solving real-world problems which involves the simultaneous consideration of multiple concurrent decision factors.

For instance, Bhaskar & Mcnamee (1983)questions the concept, commonly in the financial literature at the time, that firms strive to fulfill a single objective of maximizing profit to its shareholders. The authors argues that a more realistic model to handle the financial problem must take into consideration not only profit maximization, but several other objectives, in the sense that the shareholders are not the only agents to have their preferences satisfied and the profit maximization not the only criteria to be considered.

A classic example of a single-objective function is the portfolio selection theory proposed by Markowitz (1952, 1959)which seeks to maximize profit at a minimum level of risk, represented by the variance of the returns. Zopounidis et al. (1999) provides MCDA-based techniques to support investors on evaluating a set of 98 stocks and creating portfolio out of 15 different criteria. The authors use comprehensive additive utility functions that can easily take new stock options into consideration and reevaluate the decision. Their results indicate that important advantages of MCDA techniques over further multivariate statistical techniques, frequently employed to study financial decision-making problems.

Almeida-Filho et al., (2021) points out that different kinds of MCDA techniques have been frequently employed to support corporate DMs in a wide range of corporate financial problems with multiple objectives – sometimes concurring to each other – such as profitability maximization, risk reduction, cost minimization and environmental impact avoidance. As an example, Srinivasan & Kim (1987) examines the effectiveness of different MCDA techniques in corporate credit granting process.Years later, Jablonsk (1993)uses multi-attribute utility theory (MAUT) approach as a MCDA technique to evaluate criteria adopted of financial institutions for granting credit to their clients and how their portfolio is formed.MAUT approach is also employed by Saaty et al. (1980), Dominiak (1997) and Evrard & Zisswiller (1982) in decision problems involving portfolio selection.

Similarly, MCDA techniques have been largely used to assess corporate performance. Lee et al. (1995) proposes a model for measuring business performance from multiple criteria based on a MCDA approach. Babic & Plazibat (1998) uses multiple MCDA techniques to rank enterprises according to their business performance. Yeh et al. (2000) proposes a framework that combines fuzzy logic with multicriteria analysis to evaluate business performance levels of 10 transport companies.

Different MCDA approaches have been also employed in investment appraisal. Pearman et al. (1989) propose a multicriteria decision analysis technique to support English authorities on selecting the best investment projects among a large number of candidate projects, according to multiple acceptance criteria, DM preferences and capital budget constraint. Clintworth et al. (2018) integrate MCDA with cost-benefit analysis to assess maritime projects financed by the European Investment Bank.

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In the same token, Kivijärvi & Tuominen (1992) propose how MCDA techniques can help management staff evaluate and rank investment opportunities (with particular focus on intangible investments) along the investment planning process.

The extant literature on Corporate Finance also exhibits the adoption of MCDA approaches in Venture Capital (Muzyka et al., 1996; Riquelme & Rickards, 1992; Siskos & Zopounidis, 1987); in Country Risk Assessment (Cook & Hebner, 1993; Doumpos et al., 2001; Tang & Espinal, 1989); in the field of Capital Budgeting and Financial Planning involving multiple goals (Linke & Whitford, 1983; Spronk, 1981) and also in Merger and Acquisitions (Słowiński et al., 1997).

Although there has been demonstrable benefits of the usage of MCDA techniques in multiple areas of Corporate Finance, the application of multi-criteria decision analysis extends to further several other fields of science, such as in logistics (De La Vega et al., 2018); supplierselection(Gupta & Barua, 2018); healthcare (Öztürk et al., 2020); environmental sciences (Cegan et al., 2017) and others.

As part of this research, we evaluated the most common MCDA methods and how they fit to the problem of our case study. We relied on the previous literature review performed by Velasquez & Hester (2013) and Ceballos et al. (2016) for a comprehensive familiarization with the various MCDA techniques and variants currently available. We also drew on the literature review offered by Almeida-Filho et al. (2021) and Zopounidis & Doumpos (2002).

The adoption of MAVT to the internationalization problem

The Multi-attribute ValueTheory (MAVT)and Multi-attribute Utility Theory (MAUT) are both part of a large family of MCDA approaches and can be understood as a derivation of the von Neumann-Morgenstern's Utility Theory. Furthermore, MAUT is commonly considered an extension of MAVT in the sense it considers the existence of uncertainty into de decision model through the utility function. The technique was designed to capture DM's expectedutility values for different alternatives of a problemthrough multiple attributes, given the DM's peculiar preferences and risk profile. It also enables complex decision problems to be decomposed into a set of smaller decision issues. The individual utility measures are then recombined to retrieve consolidated utility measures (Mateo, 2012). As a result, MAUT can help DMs decide the most appropriate course of action in a decision problem by assigning expected utility values to each possible option and determining the highest utility value among them. The method excels among other MCDA methods, as it allows the DM's attitude towards risk to be incorporated into the decision model (Goodwin & Wright, 2004).

Both Multi-attribute Utility Theory (MAUT) and Multi-attribute Value Theory (MAVT) have become particularly common approach in decision analysis. Given the intuitive nature of these both techniques, they have been widely accepted as robust techniques. MAUT and MAVT are usually associated with other techniques, depending on the type of decision problem and information available.Table 1listsa few examples of applications,in which MAUT/MAVT has been employed either as single or complementary method:

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Table 1

List of publications using Multi-attribute Utility Theory

Nature of the problem	Author(s)
Financial planning decisions	Spronk (1981)
Corporate credit granting decision problem	Srinivasan & Kim (1987)
Assessment of corporate performance	Babic and Plazibat (1998)
Evaluation of multiple investment alternatives	Kivijärvi and Tuominen (1992)
Capital budget and financial planning decision problems	Linke and Whitford (1983)
Assessment of corporate performance	Lee et al. (1995)
Credit granting decision problem	Jablonsk (1993)
Portfolio selection decision problem	Dominiak (1997)
Corporate efficiency evaluation	Yeh et al. (2000)
Portfolio selection decision problem	Jog et al. (1999)
Evaluation of multiple investment alternatives	Evrard and Zisswiller (1982)
Portfolio selection decision problem	Colson and de Bruyn (1989)
Risk aversion in agricultural applications	Gomez-Limon et al. (2003)
Portfolio selection decision problem	Evrard and Zisswiller (1982)
Evaluation of multiple investment alternatives	Pearman et al. (1989)
Portfolio selection decision problem	Saaty et al. (1980)
Renewable energy projects	Kamenopoulos & Tsoutsos (2019)
Natural resource management	Vauhkonen & Ruotsalainen (2017)
Selection of a location of a global manufacturing facility	Canbolat et al. (2007)
Maintenance of a Water Supply System	Monte & Almeida-Filho (2016)
Logistics & Transportation Optimization	De La Vega et al. (2018)
Energy storage options	Murrant & Radcliffe (2018)
Natural resource management	Ananda and Herath (2005)
Reliability in energy supply systems	McCarthy et al. (2007)
Climate change	Konidari & Mavrakis (2007)
Vulnerability assessment in contaminated sites	Zabeo et. al. (2011)
Decision analysis in agricultural problems	André & Riesgo (2006)
Sustainable energy sourcing	Yilan et al. (2020)
Evacuation decisions and emergency reaction plan	Kailiponi (2010)

Developed by Keeney &Raiffa (1976), the method is well-known for its wide range of applications ranging from agricultural decision problems (André &Riesgo, 2006) to emergency plan assessment (Kailiponi, 2010). The elicitation procedures are remarkably simple, what makes the approach largely accepted by decision makers. Through a simple additive model, the preference structure is represented by a utility function $u(x_i,w)$, commonly represented as follows:

$$u(x_i, w) = \sum_{j=1}^{n} w_j u_j(x_i)$$

Where $u_j(x_i)$ represents the partial utilities from [0;1], w is a normalized vector that represents the criteria weights as per decision maker's preference structure andx_i represents the alternatives available over a set comprised of $j$different criteria. The probabilities are taken into the equation through the weights of each criterion.

One simple way to implement the principles of MAUT/MAVT is the SMART, Simple Multi-attribute Rating Technique (Edwards & Barron, 1994).

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The internationalization theory and its managerial implications

The theories of internationalization account for offering scientific explanations about the phenomenon of firms entering foreign markets and establishing different levels of operations beyond their domestic borders. The phenomenon of internationalization transforms how the company organizes itself in terms of how they communicate and coordinate geographically disperse activities(Autio & Zander, 2016), resulting in relevant effects on the national economy(Adel et al., 2018).It is not only experienced by small companies located in developed countries, but also observable in small enterprises from emerging economies, such as Brazil, China (Luo & Zhang, 2016), India (Purkayastha et al., 2021) and Tanzania (Rutashobya & Jaensson, 2004). The reasons and motivations for such companies to engage in export businesses can be explained by different aspects, such asthe characteristics of their domestic markets, entrepreneurial vocation and scarceness of relevant resourcesto the firms in their native countries (Hernandez & Guillén, 2018). More recent research has focused onunderstanding how internationalizing firms gain knowledge in international operations from their interaction with foreign firms in their native market, learning through their interactions with other enterprises such as suppliers, competitors and buyers which operate internationally (Mukherjee et al., 2021; Naughton et al., 2019). Many scholars have also concentrated efforts in explaining the drivers for internationalization from a multi-level analysis (Zahra & George, 2002) and how the interaction between the micro- and macro-level forges the first steps of small entrepreneur companies towards internationalization (Yang et al., 2020). The general literature on internationalization can be divided into two main groups: The economic models and the behavioral models. The economic models seek to explain, on a nation-wise perspective, the reasons for countries to trade to each other. On a micro-level, they focus on describing the motivations behind the firms that engage in international markets. The behavioral theories, on the other hand, shed light on why and how managers decide for internationalization under the perspective of the firm itself(Rutashobya & Jaensson, 2004).

Traditional internationalization theories from the economic branch are to some extent related to the theory of the growth to explain the internationalization of the firm. In the economic perspective, firms must create value to their shareholders and a way to achieve it is to pursue growth in international markets. The behavioral models are those, which part of this research is based on. Among the behavioral models are the transaction cost economics (TCE)approach(Williamson, 1981) andThe Uppsala process model of internationalization(Johanson&Wiedersheim-Paul, 1975; Johanson and Vahlne, 1977). The first, called TCE approach, wasbased on previous work from Ronald Coase and particularly prevailed in the decades 1970s and 1980s. Williamson argues that the costs from business trades shape how firms define their entry in foreign markets. Through three critical dimensions, uncertainty, Asset specificity and transaction frequency, the theory states that, under specific conditions, firms will seek for internationalization to reduce transaction costs. The second one,the Uppsala process model of internationalization(Johanson&Wiedersheim-Paul, 1975; Johanson and Vahlne, 1977),proposes that enterprises become international through an organic process, that starts with occasional, non-binding export opportunities and eventually evolves to a more frequent and committed activity. Many other contributions have relevant implications in the understanding of the phenomenon of internationalization, such as the Eclectic Paradigm (Dunning, 1977, 1981, 1988) and the resource-basedperspective (Barney, 1991). More recently, the conceptualization of international new ventures and born global firms as being those that envision global presence since their foundation. Firms that barely start their operations in the domestic ground and quickly project themselves to global markets (Gabrielsson & Manek Kirpalani, 2004; Oviatt & McDougall, 2005).

III. Methodology

Since different methods may result in different results (Løken, 2007), we took into consideration the practical applicability as a primary requirement for the selection of the method. We selected SMART (Edwards

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& Barron, 1994)as the technique to implement MAVT approach in the case study presented, due to the implicit transparency and simplicity offered by the technique. This helped increase the decision maker's awareness of the problem structure. Thiscondition was particularly relevant to make the case study possible, so that our decision maker would comprehend and trust the employed methodology. The **Figure 1** shows the research workflow. Through this, we expect to offer a robust literature review and a reliable foundation for further theoretical contributions (Webster & Watson, 2002).

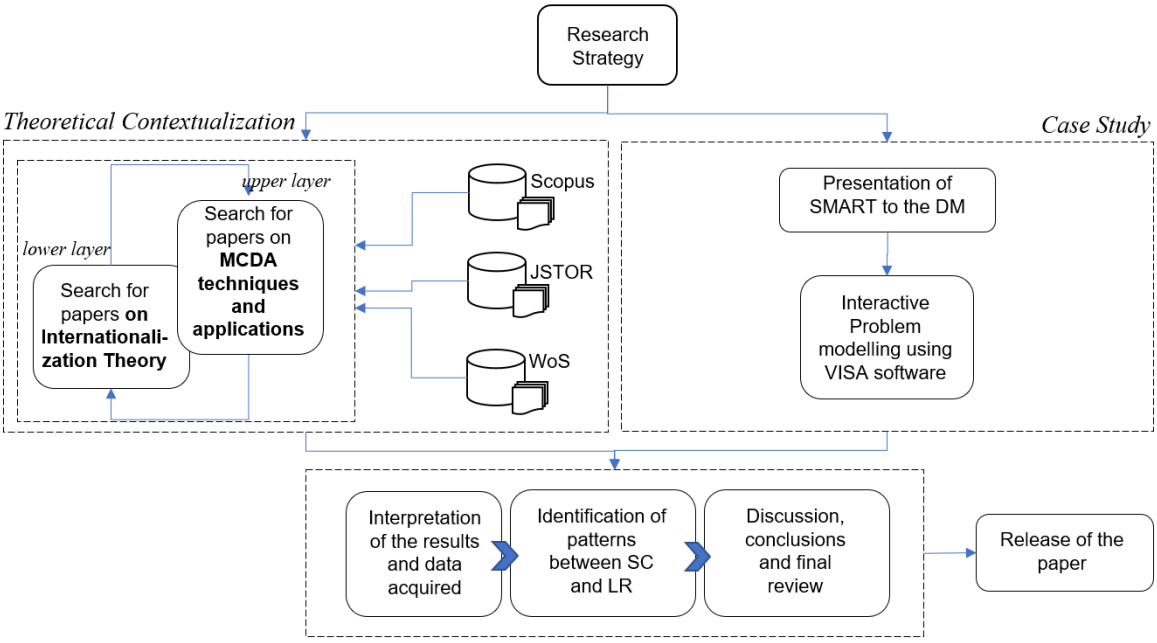

Figure 1 – Research Flowchart

We conduct a case study with the purpose of supporting a small firm's managing owner to assess the alternatives and trade-offs involved in a decision whether or not to internationalize his business operations. Scopus, JSTOR and Web of Science were used as source of scientific content, as they are deemed world's leading scientific platforms (Baas et al., 2020; Li et al., 2018). The case firm is a Brazilian enterprise identified in this work as *Le'XBolsas e assessórios*. The firm operates in the textile sector and specialized in the entire process of creating, manufacturing, cutting, assembling and packaging bags and fixtures for mothers and their babies. It started its operations in 2001 as a family business focused on producing textile goods to third-parties and quickly gained expressive domestic market share.

It started its first own brand of textile bags and accessories in 2010. The managing owner is currently pursuing to launch a new own-manufactured brand with focus on a different consumer segment, which is currently not exploited by *Le'X* business frame.

Problem Representation

This paper proposes a MCDA approach for structuring and organizing the decision problem withinthe internationalization process of small firms. The case study developed along this research was based on the criteria selected by the decision maker according to his concerns.However, we also contrasted our decision maker's criteria with those pointed by the existing literature, in order to ensure that the constructs of our study case and our MCDA approach was in line withthe mainelements of concern in thegeneral internationalization theory. With this in mind, we expect to provide a MCDA-based generalization of the internationalization problem and an effective approach to handle it.

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Le'X's business owner is planning to launch a new company with independent brand and manufacturing facility to explore different consumer segments, which are currently out of Le'X's reach. The business owner is the sole decision maker (DM) and has to decide whether to invest in one single medium-sized manufacturing site in Brazil,with a yearly production capacity of 60.000 bags and similar textile accessories or to split the investment capital into two smaller production sites.

A single production site in Brazil would not allow the firm to explore the Paraguayan market by export trades, because the logistic costs to ship the bags to Paraguay or any other foreign market would undermine itscompetitiveness. Therefore, the DM does not expect to explore export opportunities in case he decides to invest only in one site in Brazil. As a result, the turnover expected by this single site is limited to the total sales accrued in Brazil. The city of Belo Horizonte, State of Minas Gerais, Brazil is deemed to be the most strategic location to host the manufacturing site, according the marketing analysis performed by Le'X,

Alternatively, in case the DM decides for the two sites scenario, the plants will be installed simultaneously, so that both sites can initiate the production at the same time. In this scenario, the annual production capacity of each small site would reach 35.000 units, which is approximately the half capacity of the case of single medium-sized facility. The **Table 2** summarizes the DM's alternatives to the problem.

Table 2
Possible outcomes / decision scenarios

Alternatives	Number/size of manufacturing sites	Candidate location	Production Capacity	Estimated Investment (in BRL)
Scenario 1: Operate in the domestic market only	01, medium-sized	Belo Horizonte, Brazil	60.000 bags	$3.500.000
Scenario 2: Operate in both domestic and foreign markets	02, small-sized	Luque, Paraguay Belo Horizonte, Brazil	35.000 bags per factory	$ 1.900.000 per factory

Should the DM decide for investing in two smaller factories, one of them will still be located in Belo Horizonte, Brazil and the other, in Luque, Paraguay. This scenario, despite displaying a higher operating cost over time, will allow the firm to access a wider consumer market and increase revenue from different regions. Besides, the firm will be less dependent on one single market. For this scenario, the production sites will have approximately the same manufacturing capacity and the owner will benefit from having them located in different countries. The owner estimates that the one single location scenario will require about R$ 3,5 million for an average annual output of 60.000 bags and fixtures.

Should the scenario 2 be selected, each one will have a production capacity of 35.000 bags plus accessories, with investment costs amounting to R$ 1.9 million each. The prospect of building two smaller factories in different geographies seems particularly attractive to the decision maker for multiple reasons. The scenario 2 is presumed to yield also some intangible benefits to the organization, in terms of foreign networking, higher exposure to innovative ideas coming from foreign markets and the opportunity to access resources beyond the domestic borders. For this reason, the decision maker refuses to have a decision analysis limited to mere financial factors.

According to the business owner, the decision shall also consider the goodwill that a foreign location may produce. Therefore, the alternatives are to be appraised through various criteria, some of them of financial nature while others envision a strategic perspective. Additionally, the decision whether to establish an operation only in Brazil or in both countries Brazil and Paraguay depends multiple objectives with different level of importance to the decision maker. The investment decision also involves a great amount of capital because of this, the decision maker wants to ensure that the final decision represents the best possible outcome.

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Conducting the case study with the business owner

As per the understanding of Dwivedi et al. (2008), case study is a largely employed method for investigating effects of the technology adoption in different research contexts. We planned our study case research based on the practices suggested by Cauchick (2007) and Brannen (2005). We also took into consideration the practices described by Coombs, (2017), in order to avoid deviations from the research plan during the work execution phase.

The decision maker was invited to attend remote videoconference calls. In the first virtual audience, the decision maker presented his professional background and his problem concerning whether or not to internationalize his new business venture. During this first meeting, the most important criteria for the decision maker were determined and registered.

The second meeting was dedicated to review the problem information in a more structured format. This allowed the decision problem to be better understood by the decision maker itself and by the authors. The preliminary options were also appraised and discussed. We used the software VISA version 8.0 (Belton et al.,1986-2014) as the tool for facilitating visual and interactive contact with the decision maker, so that we couldensure that the interactions during the case study would be completely assimilated by the DM.

VISA stands for Visual Interactive Sensitivity Analysis and it is widely used for modelling and simulating decision problems with multiplefactors and different weights. VISA allows also users to transparently conduct sensitivity analysisthrough small changes in score or weight for the given alternatives and criteria.

A third and final meeting were conducted with the DM to refinethe problem data and secure that it represented his perceptions and preferences, before theresults were presented and analyzed.

We have deployed SMART to our case study with basis on the stages described by Edwards & Barron (1994) andGoodwin & Wright (2004), as follows:

Stage 1: We have properly identified the decision maker andits role in the case study. In the case, we have considered only one decision maker, however, Le'X's is owned by two individuals.

Stage 2: In this step we defined what were the options of the decision maker. These options, or alternatives, are given in terms of two strategic scenarios, shown in the Table 2. It is relevant to mention that other alternatives could obviously have been considered in the problem definition. However, other alternatives were not considered of the strategic interest of the business owner and therefore, were not considered in the case study.

Stage 3: The next step was focused on determining the criteria considered relevant to the decision maker for the decision process. We have selected a number of 11criteria,which properly represent relevant factors to the decision maker. The criteria were divided into two groups of benefits and costs, as shown in the Table 3 below.

Table 3

List of criteria adopted in the case study

Group	Criterion	Reference literature
Benefits	Competitiveness	Chang & Webster (2019)
	Innovativeness	
	Access to qualified HR	Tolstoy and Agndal (2010);
	Annual revenue	
	Networking growth	Matanda and Freeman (2009); Boehe (2013); Eberhard and Craig (2013);
	Operational diversification	Bruneel et al. (2010); Mesquita and Lazzarini (2008)
Costs	Compliance, laws and regulations	
	On-time investment costs	
	Rent and household	
	Personell	
	After-sales costs	

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Stage 4: The fourth phase the decision maker was asked to estimate the performance of each alternative throughout the adopted criteria. At this stage, decision maker measured the performances based on his previous experiences and based on the business case his company had conducted a few months ago. This company's business case contained some relevant financial data that supported the DM to answer some of the questions, particularly those related to cost figures. The figures were considered out of date and therefore were accepted to be disclosed by the decision maker. The performance measurements are given in the **Table 4**

Stages 5 and 6: At this phase, the decision maker is asked to assign a weight for every criterion. This process defines the relative importance of each criterion to the decision maker. After that, weighted average of the values assigned to every alternative is calculated. The literature provides a large range of weighting techniques. Some of these methods are based on a subjective judgment and, therefore, require the decision maker to be an expert in the subject of analysis or the presence of a specialist to support in the weighting process. Some of the most common subject weighing methods are the pairwise comparison, used by Analytical Hierarchy Process (Saaty, 1977), swing method, ratio method, rank order centroid (ROC) approach and direct rating techniques. This study adopted the swing weighting method, which is attained by requesting the decision maker to compare a swing from the least preferred value to the most preferred value throughout different criteria (Goodwin & Wright, 2004). The criterion with most preferred swing is rated with highest weight, whereas the least preferred criteria is given lower weight. For this procedure, we followed the steps suggested by Parnell & Trainor (2009).

Stage 7: The decision problem is, at this point, completely described and all input data are gathered. The decision maker is then asked to take an initial decision.

Stage 8: A sensitivity analysis is performed. The DM's decision is then assessed upon the changes in the input data. Because the study case was performed in a very iterative way, fine adjustments in the weights were performed, however, it produced no effect in the final result.

Table 4

List of criteria adopted in the case study

Group	Criterion
Benefits	Competitiveness
	Innovativeness
	Access to qualified HR
	Annual revenue
	Networking growth
	Operational diversification
Costs	Compliance, laws and regulations
	Machinery & Manufacturing infrastructure (incl. Instalation and set-up)
	Rent and household
	Personell
	After-sales costs

IV. Results

As a result of the stages 1 and 2, a decision tree was created in order to properly represent the decision problem and the possible course of actions.VISA tool was used to build the decision tree, according to the criteria listed in the **Table 3.** The organization of the criteria

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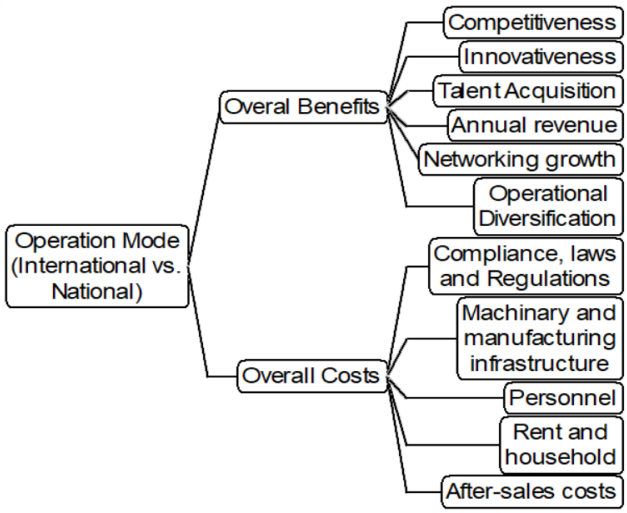

Figure 2: Decision tree for the mode of operation

We have then performed the verification steps proposed by Keeney and Raiffa (1976) in order to ensure that the final decision tree would provide an accurate representation of the decision maker's concerns. Conditions such as the i. completeness; ii. operationality, ii. decomposability weretested. Additionally, the decision tree was successfully checked against iv. redundancies and v. minimum size was achieved as shown in the Figure 2. During the teleconference sessions with the decision maker, the costs associated with each course of action were estimated by means of a series of questions. Table 5 indicates the cost positions for one assembly plant in Brazil, what we called 'scenario 1', corresponding to a medium-sized plant structure with yearly production capacity of 310.000 bags and textile accessories.

Table 5

First Year Cost Estimation - Brazil Only (Scenario 1)		
Cost Position	Cost Type	Amount R$ per annum
Compliance, laws and regulatory costs	Fixed + 15% var.	$150.000
Machinery and manufacturing infrastructure	One-time	$3.500.000
Personnel costs	Fixed	$984.000
Rent and general household costs	Fixed	$96.000
After-sales costs	Variable	$66.000
		$4.796.000

Similarly, the costs associated to the establishment of a plant in Luque, Paraguay, were estimated and gathered during the teleconference sessions with the decision maker. In order to ensure independency among the alternatives and criteria, individual cost estimations were conducted for each case separately and then summed up for the case described in the scenario 2, which considers the implementation of two smaller production sites in two different locations. The Table 6 presents the cost estimation for the production facility in Paraguay.

Differences in cost positions between both locations are explained by price practices in each country. According to the DM, prices practiced by service firms in Paraguay are lower than in Brazil. For instance, law firms, security service providers and cleaning services are about 20% cheaper in Paraguay, partially because of the tax rate adopted by the Paraguayan government, which is lower than in Brazil.

Investments in machinery and manufacturing infrastructure, on the other hand, are expected to be the same irrespective of the scenario, as the equipment are imported from China. Since the differences in logistics

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costs to ship the machinery from Chinese suppliers to Brazil or Paraguay are irrelevant, the final investment costs for the factory are deemed the same. In this case, the production capacity would be split into two smaller locations.

Table 6

First Year Cost Estimation - 2 Locations: Brazil and Paraguay (Scenario 2)		
Cost Position	Cost Type	Amount R$ per annum
Compliance, laws and regulatory costs	Fixed + 15% var.	$262.500
Machinery and manufacturing infrastructure	One-time	$3.800.000
Personnel costs	Fixed	$1.230.000
Rent and general household costs	Fixed	$171.000
After-sales costs	Variable	$66.000
		$5.529.500

One disadvantage of having two assembly lines in different locations is that no synergy can be obtained from the employees in the factory. As a result, the firm experiences higher personnel costs as some positions as production manager, controlling and sales teams must be duplicated in order to proper meet the business needs of each location separately. This situation illustrates the importance of a well-structured decision process for the internationalization case. While the benefits are considerably attractive to the business owner and motivates a decision towards multiple manufacturing locations, the downside of the operation are the additional operating costs related to existence of independent operating plants. After-market costs refer to general expenditures on recalling defective products or costs associated with the assistance of customer complaints.

These costs are usually proportional to the total production volume. As there is no difference in the production capacity between scenario 1 and 2, the after-sales costs are not expected to differ from one scenario to the other.

As shown in the decision tree (Figure 2), one of the criteria is the net revenue each alternative can bring. The total net revenue depends on the yearly total sales, production costs at each assembly plant, general administrative costs (SG&A) and other expenditures, including taxes. Because the information as to the yearly expected turnover were promptly available during the conference calls with de decision maker, the data from his business plan was organized in form of an Income Statement. The Table 7 synthetizes the financial data used to model the figures for the criterion revenue.

Table 7

5yr-estimate Income Structure - Case 1: Operation **in domestic market only**

	2023	2024	2025	2026	2027
Total Gross Sales	*3.900.000*	*4.048.200*	*4.202.032*	*4.361.709*	*4.527.454*
Direct Taxes (PIS/COFINS) *[13,25%]*	*-516.750*	*-536.387*	*-556.769*	*-577.926*	*-599.888*
Total Net Sales	*3.383.250*	*3.511.814*	*3.645.262*	*3.783.782*	*3.927.566*
Production Costs *[1 location, 310.000 un.]*	*-1.251.803*	*-1.299.371*	*-1.348.747*	*-1.399.999*	*-1.453.199*
SG&A	*-1.296.000*	*-1.345.248*	*-1.396.367*	*-1.449.429*	*-1.504.508*
EBITDA	***835.448***	***867.195***	***900.148***	***934.354***	***969.859***
Depreciation & Amortization	*-350.000*	*-350.000*	*-350.000*	*-350.000*	*-350.000*
Financial Expeditures	*0*	*0*	*0*	*0*	*0*
EBT	***485.448***	***517.195***	***550.148***	***584.354***	***619.859***
Income taxes + CSSL *[34% o.EBT]*	*-165.052*	*-175.846*	*-187.050*	*-198.680*	*-210.752*
Net Revenue	***320.395***	***341.348***	***363.098***	***385.673***	***409.107***

Although the income statements for the scenarios 1 and 2 were drawn over a business horizon over five years, the relevant financial data for the decision process was focused on the year 2023. The annual business

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growth rate was estimated in 3,5%. Moreover, the investment phase is expected to take the entire year 2022. Therefore, the first year of production of both production plants is expected to take place in beginning 2023.

The investment in machinery and manufacturing infrastructure is depreciated over a 10-year period. Therefore, for the scenario 1 with a total investment in amount of R$ 3,5 million, the annual depreciation cost is calculated to R$ 350.000.

The Table 8 shows the income statement for the scenario 2. In this case, the decision maker informed that the average tax burden in Paraguay in lower than in Brazil. The taxation takes place by means of an IVA tax, which amounts about 10%. As a result, the average tax collection between both sites in Brazil and Paraguay will be lower than a single site in Brazil. This represents a positive fact, in contrast to the general administrative costs (SG&A), which proved to be expressively higher in the scenario 2. This happens because the total costs for having two locations is higher than for having only one, since costs with rent and other household expenses occur in double.

Table 8

5yr-estimate Income Structure - Case 2: Operation **in domestic & foreign markets**

	2023	2024	2025	2026	2027
Total Brutto Sales	*4.550.000*	*4.722.900*	*4.902.370*	*5.088.660*	*5.282.029*
Direct Taxes (PIS/COFINS/**IVA**) *[13,25%, 10%]*	*-528.938*	*-549.037*	*-569.901*	*-591.557*	*-614.036*
Total Net Sales	*4.021.063*	*4.173.863*	*4.332.470*	*4.497.104*	*4.667.993*
Mixed Production Costs	*-1.487.793*	*-1.544.329*	*-1.603.014*	*-1.663.928*	*-1.727.158*
SG&A	*-1.713.500*	*-1.778.613*	*-1.846.200*	*-1.916.356*	*-1.989.177*
EBITDA	***819.769***	***850.921***	***883.256***	***916.819***	***951.658***
Depreciation & Amortization	*-380.000*	*-380.000*	*-380.000*	*-380.000*	*-380.000*
Financial Expeditures	*0*	*0*	*0*	*0*	*0*
EBT	***439.769***	***470.921***	***503.256***	***536.819***	***571.658***
Avg. Income taxes + CSSL *[28% o.EBT]*	*-123.135*	*-131.858*	*-140.912*	*-150.309*	*-160.064*
Net Revenue	***316.634***	***339.063***	***362.344***	***386.510***	***411.594***

Additionally, the corporate income tax rate in Paraguay is also lower than in Brazil. This carries also a positive effect on the net revenue for the scenario 2, with lower average tax rate of 28% between both locations.

Table 9

Tax rates in Brazil and Paraguay considered for the net revenue criteria

Location	Taxation Instrument	Taxation rate
Brazil	PIS/COFINS	13,25%
	IRPF + CSSL	34%
Paraguay	IVA	10%
	CIT	22%

The decision maker was requested to estimate how each alternative course of action, represented by the scenarios 1 and 2, performs over every individual criterion. The cost and net revenue criteria offered quantitative measurement units and, therefore, they were obtained by the dynamic exercise explained before and then easily estimated based business data previously known by the DM.Some of the criteria have rather a qualitative nature, such as innovativeness and competitiveness. Because of this, no quantitative performance indicator could be assigned to them.For such cases, we used the direct rating technique to capture the DM's preference. During the direct rating, the DM was requested to rank his alternatives from most to least preferred. The most preferred alternative was given a score 100, whereas the least preferred alternative was assigned with

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a score of zero. The intermediate alternatives were allocated between the most and least preferred alternatives, according to a relative perception of improvement from one alternative to another.

For those criteria that could be easily quantified, we used value functions to measure the performance of the options. For instance, the decision maker's relative strength of preference for the number of new talented employees is presented in the**Figure 3**.

Figure 3.1 – Value functionfor Firm's competitiveness

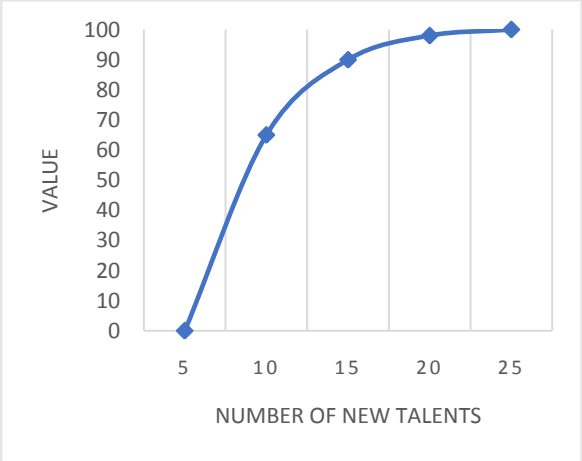

Figure 3.2 – Value function for number of new talents

Alternatively, some criteria were represented in terms of a discrete scale. This seemed to be the most reasonable way to measure the performance of the options on qualitative criteria, such as Competitiveness, Innovativeness and Networking growth. For those criteria, we adopted a Likert 5-point scale to rate options by means of linguistic expressions ranging from 'Worst', representing the lowest score possible to 'Excellent', meaning highest score possible.

Table 10

5-point Likert scale for qualitative criteria: Competitiveness, Operational Diversification, Innovativeness and Network growth

Value	Wording	General meaning to all qualitative criteria
0	Worst	No benefits are perceived
25	Poor	Little or unremakable positive effects are perceived
50	OK	Reasonable positive effects are perceived
75	Good	More than acceptable effects are perceived
100	Exl	Outstanding effects are perceived

The procedure of determining the weights of each criterion was conducted through a series of questions to the decision maker based on the hypothetical option for the decision problem with all criteria performing at their worst values. Then, the DM is asked to pick one criterion, whose performance value could be changed its highest level. The DM is asked again, until all criteria have been ranked, following the DM's sense of importance(Goodwin & Wright, 2004; Parnell & Trainor, 2009). The first selected criterion is called 'alfa-criterion' and it is given a weight value of 200. DM is, then, asked how a change from the worst to the best level of the subsequent criteria compares to a same change in the alfa-criterion. The relative result is given in terms of a percentual quantification of relative importance of that criterion against the alfa-criterion. This technique was repeated until all eleven criteria have been properly weighted, as shown in the **Table 11**. An alternative approach was also employed later during the overall review on how the problem had been structured. It

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consisted on asking the decision maker once again to assign weights to the criteria, but now, starting from the least important one. The decision maker assigned a value of ten to the criteria 'after-sales costs'. Then 'machinery and manufacturing infrastructure' was compared to 'after-sales costs' to obtain the ratio of relative importance to each other. The decision maker gave a value of 20 to 'machinery and manufacturing infrastructure'in relation to 'after-sales costs'. The criteria 'networking growth' was then compared to the previous criteria and given a value of 30. This means, therefore, that the decision maker considers the criteria 'networking growth'3 times more important than 'after-sales costs' and 1,5 times more important than 'machinery and manufacturing infrastructure'. Same process was repeated in an iterative way, until the decision maker seemed comfortable with the weight spread. In some cases, we had to give a step back and revise weight values already evaluated, because the relative comparison from one attribute to others was conflicting. For instance, 'competitiveness' was initially compared to 'talent acquisition' and was given a weight of 120, i.e. 3 times more important. Then, 'competitiveness' was compared to 'innovativeness' and was deemed 2 times more important, leading to a value of 100, what was incoherent. Because of this, the relative weights had to be reassessed every time such inconsistencies appeared, until the values assigned by the decision maker proved to be consistent to his overall sense of importance.

Table 11

Rank of criteria based on the swing weighting method

Criteria	Weight assigned by the decision maker	Normalized Weight
Annual Revenue	200	0,2299
Competitiveness	160	0,1839
Rent and household expenses	110	0,1264
Personnel costs	100	0,1149
Operational Diversification	90	0,1034
Compliance, laws and Regulations	60	0,0690
Innovativeness	50	0,0575
Talent Acquisition	40	0,0460
Networking growth	30	0,0345
Machinery and manufacturing infrastucture	20	0,0230
After-sales costs	10	0,0115
	870	*1,0000*

The weighting process has englobed all criteria similarly. Therefore, benefits and cost-related criteria were weighted based on the same procedures.This step has initially required additional explanations to the decision maker, so that he could clearly perceive all criteria, whether benefits or costs with the same perspective.

Additionally, we have estimated ranges of values of each criterion and their most likely values. The Table 12 shows, for each scenario, the most likely value, the maximum plausible value (*'max plausible'*) and the minimum plausible value (*'min plausible'*). The indicators *max%* and *min%* provide the percentual information of how far the most likely value is from its maximum plausible and its minimum plausible values. These estimations have been captured through an interactive set of questions to the decision maker until he felt comfortable with the ranges for each criterion and for each scenario separately. This process was particularly important because each criterion carries a specific level of uncertainty, which depends on the very nature of the criterion and the scenario. For instance, the criterion Annual Revenue displays a min% and max% range varying from -10% to +15% in the scenario 1 and a range from -18% to +22% in the scenario 2. This occurs because the

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DM feels more certain about the range for expected revenue if the business operation is located only in Brazil, as his past business experiences are in the domestic market. On the other hand, when he is asked about the maximum and minimum plausible revenues for the scenario 2, which includes the Paraguay business, the decision maker is more uncertain due to lack of experience in foreign markets. This uncertainty is expressed in terms of a wider range of possible revenues.

Similarly, the max and min plausible values don't swing symmetricallyaround the most likely values, as indicated above. This is also explained by the level of sureness displayed by the decision maker during the interviews. As a result, many of the ranges have an unequal spread around the most likely values, what allowed the decision maker perception's to be captured with very high accuracy.

Table 12

Overall scores for Scenario 1 and 2

	Annual Revenue	Personnel	Rent and household expenses	Competitiveness	Operational Diversification	Compliance, laws and Regulations	Innovativeness	Talent Acquisition	Networking growth	Machinery and manufactur-ing infrastucture	After-sales costs
Swing weight (W)	*0,2299*	*0,1149*	*0,1264*	*0,1839*	*0,1034*	*0,0690*	*0,0575*	*0,0460*	*0,0460*	*0,0230*	*0,0115*
Scenario 1 (domestic operation only)	61,88	86,89	97,10	25,00	0,00	96,54	50,00	20,00	50,00	84,30	11,10
Scenario 2 (domestic & foreign operations)	50,00	21,31	6,60	100,00	100,00	10,09	75,00	60,00	75,00	17,04	87,99
SCENARIO 1	**320.395**	**984.000**	**96.000**	**POOR**	**WORST**	**150.000**	**OK**	**3**	**OK**	**3.500.000**	**66.000**
max plausible	*330.007*	*1.033.200*	*98.400*			*154.500*		*5*		*3.570.000*	*68.310*
min plausible	*310.783*	*934.800*	*93.600*			*145.500*		*2*		*3.430.000*	*63.690*
max%	*3,00%*	*5,00%*	*2,50%*			*3,00%*		*50,00%*		*2,00%*	*3,50%*
min%	*-3,00%*	*-5,00%*	*-2,50%*			*-3,00%*		*-50,00%*		*-2,00%*	*-3,50%*
SCENARIO 2	**316.634**	**1.230.000**	**171.000**	**EXL**	**EXL**	**262.500**	**GOOD**	**6**	**GOOD**	**3.800.000**	**50.000**
max plausible	*332.466*	*1.309.950*	*176.472*			*275.625*		*9*		*3.876.000*	*52.500*
min plausible	*300.802*	*1.150.050*	*165.528*			*249.375*		*3*		*3.724.000*	*47.500*
max_plausible%	*5,00%*	*6,50%*	*3,20%*			*5,00%*		*50,00%*		*2,00%*	*5,00%*
min_plausible%	*-5,00%*	*-6,50%*	*-3,20%*			*-5,00%*		*-50,00%*		*-2,00%*	*-5,00%*
Function_Max	332.466	1.309.950	176.472			275.625		9		3.876.000	68.310
Function_Min	300.802	934.800	93.600			145.500		2		3.430.000	47.500

Once the weights for the criteria and the most likely values and respective ranges were available, we determined how each scenario performed on every criterion. These values were obtained by using two different equations (Olson, 1996), according to the nature of the criterion in order to normalize the values in an interval ranging from 0 to 100.

The **Eq.1** below was used onall criteria, which respond to the logic "the lower, the better", such as personnel costs, rent and household expenses, costs with compliance, laws and regulations, costs with machinery and infrastructure and after-sales costs for both scenarios 1 and 2. The use of a specific equation to those criteria is useful in order to ensure that the resulting scores move compatibly with the criterion logic, e.g. the higher the values of expense-related criteria are, the lower its respective performance score will be. For instance, the most likely personnel cost for the scenario 1 is R$984.000 against R$1.230.000 in the scenario 2. The resulting performance score must, therefore, be higher for the scenario 1 and lower for the scenario two. As shown in the **Table 12**, the scenario 1 scores 75,00 whereas scenario 2 score 66,67. This mathematical procedure secures that the less expensive scenario – therefore the most attractive one – will perform higher on that criterion.

$$ScoreCosts = \frac{100 * (\text{MaxPlausible} - \text{MostLikely})}{(\text{MaxPlausible} - \text{MinPlausible})} \qquad \text{(Eq.1)}$$

Similarly, the **Eq.2** below was applied to all criteria which properly comply with the logic "the higher, the better". This logic applies to those criteria which are deemed a benefit to the decision maker, such as 'annual revenue' and 'talent acquisition'. This can also be noticed from the **Table 12**. The most likely value for 'net revenue per year' expected by the decision maker in the scenario 1 is R$320.395. After normalized against its maximum and minimum plausible values, it renders a score 60,00. On the other hand, the scenario 2 displays a most likely net revenue per year of R$305.114, which results in a score 55,00, given the maximum and

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minimum plausible values for that individual scenario. This response indicates that the score moves in compliance with the logic "the higher, the better".

$$ScoreBenefits = \frac{100*(\text{MostLikely} - \text{MinPlausible})}{(\text{MaxPlausible} - \text{MinPlausible})} \qquad \text{(Eq.2)}$$

This technique also ensures that the computation of the normalized scores is bounded by the overall maximum and minimum plausible values of both scenarios. For example, the maximum and minimum plausible values estimated by the DM for the criterion 'compliance, law and regulation costs' over both scenarios 1 and 2 are, respectively, R$275.625 and R$145.500, as shown in the **Table 12**. As the most likely values for both scenarios are found within this range, the normalized performance scores, obtained by the equations above, are also found within the range from 0 to 100. This ensures proportionally and coherence for all set of values the scenarios may assume.

Finally, the criteria 'competitiveness', 'operational diversification', 'innovativeness' and 'networking growth' are of qualitative nature and their values are rather descriptive, as detailed in the **Table 10**. For these cases, the score ranges from 0 to 100 in steps of 25 points.

Since a value-based measurement model has been adopted to capture the decision maker's order of preference, an overall score can be obtained to each alternative by means of the Eq.3 below. The scores assigned to each alternative provides a preference order in numerical form (Løken, 2007), so that the alternative x_1 is preferred to the alternative x_2, if and only if $V(x_1) > V(x_2)$.

$$v(x) = \sum_{i=1}^{n} w_i v_i(x_i) \qquad \text{(Eq.3)}$$

Where wi represent the weight assigned to the ith criterion, as shown in the Table 11, and vi(xi) indicates the normalized score of the alternative xi on that criterion. This results in a consolidated score for each alternative, which are represented in our problem by the Scenarios 1 and 2. The weights and normalized scores for each scenario were extracted from the Table 12 and depicted in the Table 13 for a better representation. The overall score for Scenario 1 is

then calculated through the Eq.3 and can be represented by the following expression:

Table 13

Weights and normalized scores on every criterion for ***Scenario 1***	Annual Revenue	Personnel	Rent and household expenses	Competitiveness	Operational Diversification	Compliance, laws and Regulations	Innovativeness	Talent Acquisition	Networking growth	Machinery and manufacturing infrastucture	After-sales costs
Swing weight (W)	*0,2299*	*0,1149*	*0,1264*	*0,1839*	*0,1034*	*0,0690*	*0,0575*	*0,0460*	*0,0460*	*0,0230*	*0,0115*
Scenario 1 (domestic operation only)	*61,88*	*86,89*	*97,10*	*25,00*	*0,00*	*96,54*	*50,00*	*20,00*	*50,00*	*84,30*	*11,10*

*V(Scenario1) = 61,88*0,2299+86,89*0,1149+97,10*0,1264+25,00*0,1839+0,00*0,1034+96,54*0,0689+50,00*0,0575+20,00 *0,0460+50,00*0,0460+84,30*0,0230+11,10*0,0115*

Therefore, V(Scenario 1) equals 55,90.

Same calculation is then performed for the Scenario 2, based on the criterion's weights and their normalized scores, as displayed in the Table 14.

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Table 14

Weights and normalized scores on every criterion for ***Scenario 2***	Annual Revenue	Personnel	Rent and household expenses	Competitiveness	Operational Diversification	Compliance, laws and Regulations	Innovativeness	Talent Acquisition	Networking growth	Machinery and manufacturing infrastucture	After-sales costs
Swing weight (W)	*0,2299*	*0,1149*	*0,1264*	*0,1839*	*0,1034*	*0,0690*	*0,0575*	*0,0460*	*0,0460*	*0,0230*	*0,0115*
Scenario 2 (domestic & foreign operations)	*50,00*	*21,31*	*6,60*	*100,00*	*100,00*	*10,09*	*75,00*	*60,00*	*75,00*	*17,04*	*87,99*

*V(Scenario2)=50,00*0,2299+21,31*0,1149+6,60*0,1264+100,00*0,1839+100,00*0,1034+10,09*0,0689+75,00*0,0575+60,00*0,0460+75,00*0,0460+17,04*0,0230+87,99*0,0115*

Therefore, V(Scenario 2) equals 56,13.

The **Figure 4** indicates the how each scenario's score is composed in terms of their components w_i*v_i and supports the initial claim from the decision maker that operational diversification, competitiveness and talent acquisition were relevant factors in the decision process.

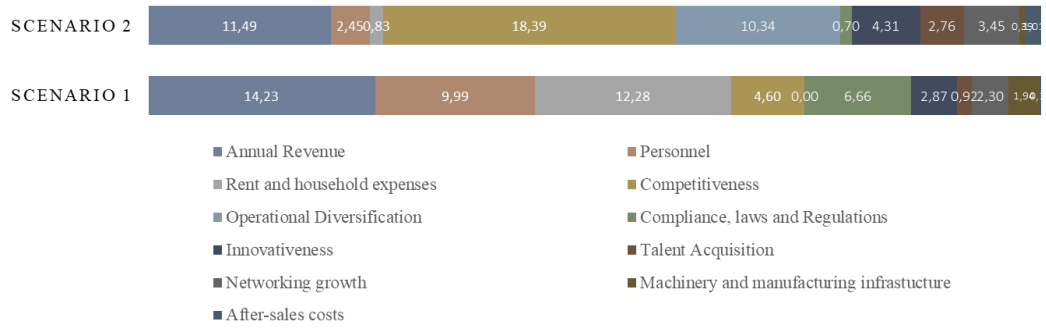

Figure 4: Composition of w_i*v_i for each scenario

This indicates that an evaluation purely based on financial requirements such revenue and costs would certainly lead to a decision towards scenario 1. However, as the decision model also integrated further strategic components that were relevant to the decision maker and goes beyond the financial criteria, the decision model recommended the scenario 2 as the most adequate solution, according to the structure of preferences captured from the decision maker during the process. The figure 4 also supports the conclusion that the criteria 'competitiveness' and 'operational diversification' are outliers in the scenario 2, since they both have relevant importance in the decision maker's perception (see **Table 11**) and facilitated the scenario 2 achieve a marginally higher overall score.

In the final stage of this work, we have conducted a sensitivity analysis on the recommended solution for the decision problem. The recommended solution pointed the Scenario 2, i.e. operating in both domestic and foreign scenarios, as the preferred alternative. We simulated gradual changes of the weights in order to force the model to change its recommendation to the Scenario 1 through different combinations. We then asked the decision maker whether the new set of weights would also make sense to him, without showing him how the model responded to the recommendation. However, the decision maker refused all the three new sets of weight values, pointing them as incompatible with his structure of preferences. The decision maker was indifferent to

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our attempt of modifying the weight values through tiny increments or decrements, however these changes were not enough to alter the overall recommendation of the decision model.

V. Discussions

As Velasquez & Hester (2013) describes, Multi-Criteria Decision Analysis has proven to be a valuable option for supporting decision makers in a very large amount of problems. Although the decision process relies subjective quantities of the input data (Edwards, 1977), an extensive review of the decision maker's preferences and how they have been elicited produced a reliable method for supporting the decision and increased the decision maker's confidence on his business options. The application of a MCDA approach to support a more structured decision on the internationalization of the case firm also validates previous findings from De La Vega et al. (2018), in the sense that decision problems involving complex criteria, which are difficult to quantify in single mathematical models, may find a helpful hand in MCDA methods.

VI. Conclusions

We presented in this paper a case study conducted by the authors with focus on supporting a small-sized firm's managing owner in the textile sector to structure relevant business information and use them to assess his alternatives with respect to the business operation mode he could choose for a spin-off firm. The business owner should decide whether to establish the operation of the new enterprise only the domestic market in a single location or to split the investments into two smaller assembly lines, with locations in Paraguay and Brazil. This dilemma has been increasingly experienced by small business owners that discover potential business opportunities in foreign markets (Cavusgil & Knight, 2015; George et al., 2005).

We assume that the approach proposed by this paper is a worthwhile guidance to small-sized enterprises from multiple industrial sectors that face similar business internationalization dilemma. As a result, the MCDA approach offered by this study can be generally extended to small business owners, who are also seeking for a well-structured decision technique to handle the decision problem concerning the internationalization of their operations. The approach involves concepts of accounting and requires information on the tax policy adopted by country, which must be used to calibrate the values of the model when applied to different cases. However, the study revealed some important limitations that one must to take into consideration before using it.

Firstly, different business sectors exhibitfeatures and propertiesmuch wider than those used to construct this application. As a result, this application may prove to be restricted only to firms with similar profile of the one used as case study.

Secondly, a certain level of bias from the decision maker must be taken into account. During the interactions, the decision maker demonstrated to the prospect of the internationalization of this business. This may have brought to the decision process a certain level of initial preference that could have channeled the results to the international scenario.

VII. References

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