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TOPIC MODELING: THE USE OF MACHINE LEARNING AND REFERENCE MANAGEMENT SYSTEMS IN THE AREA OF INTERNATIONALIZATION OF SMALL AND MEDIUM ENTERPRISES (SMES)

The objective of this paper is to find new trends in the literature using machine learning and reference management systems within the theme of the Internationalization of Small and Medium Enterprises (SMEs). With help of topic modeling software 857 articles on the topic "Internationalization of SMEs from 2012 to 2021 were analyzed and ranked (citation index) through Endnote[®] library management systems. The search was focused only on the fields of social science and management. 85 documents were shortlisted from the original cluster to proceed with the text mining. Results show promising areas of research within the Internationalization of SMEs. Stand-out topics include Resource-based Theory, Dynamics Capabilities, International Entrepreneurship, and Ambidexterity among others.

Endnote[®] Subject Bibliography found the most popular words and topics in the original database. Results showed that using Endnote[®] and MALLET topic modeling tool it is possible to analyze large amounts of publications and find new trends within a specific field. However, MALLET software needs experts in the field to identify and translate results into meaningful ideas. Endnote[®] seems to have a higher level of sophistication and a better visual interface, but among the disadvantages are the price of the tool and that it works better with their libraries or partner journals.

Keywords: Internationalization, SMEs, MALLET, Endnote, Survey Literature.

1. INTRODUCTION

Nowadays young generation individuals are deeply interrelated with technology, the internet, and smartphones. Members of these groups are generally satisfied with their level of integration with technology in their daily life. However, researchers might be cautious when using web 2.0 tools in their doctoral research, due to financial constraints, lack of technological expertise for both the students and institutions and limited guidance from their supervisors during the early stages of research.

Carpenter (2012) found in the London study that more than 27% of Ph.D. students had not used any technology aid for the research. Furthermore, the study showed that citation

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and reference management systems (Endnote[®], Mendeley, RefWorks etc.) are the preferred technologies (58%), and other types of tools were used by 10% of the responders or less. Some librarians find Endnote[®] a great resource for academic research, especially for systematic reviews. However, it is also considered to be not intuitive, especially for first-time users who need specific training and supervision to kickstart literature analyses (Gotschall, 2021).

Lately, the use of machine learning applied for research is growing (Qiang, Qian, Li, Yuan, Wu, 2020). Machine learning through topic modeling determines a theme from words that are part of texts. It reads hundreds of thousands of documents and figures out which words in those documents are related. After that, the system interprets topics by ranking keywords that are more likely to appear to be repeated (Block, 2006). An experienced scholar may use those words to title each list with a meaningful heading that can be used for further analysis.

In the words of Meeks and Weingart (2012), Topic Modelling is “*a distant reading in the purest sense*” usually, being able to see the big picture helps researchers to figure out a complex situation. However, getting conclusive results from Topic Modeling is practically impossible because it requires much intangible information like intuition and creativity. Still, it is a helpful exercise that uses complex formulae, algorithms, statistics, and probabilities to analyze large amounts of words and produce intercorrelated words that can be translated into new topics and research trends in literature.

Finding new trends in the literature is a difficult time-consuming task that might result in a loss of motivation and frustration for researchers. Using topic modeling software can help to find meaning in keywords that are generally taken for granted while easing the task of reading hundreds of documents.

The *Topic Modeling tool* is a graphical user interface for MALLETT (Machine learning for language toolkit) developed by McCallum (2002). Also, the tool gets together the words that are likely to emerge in a collection of documents. The tool uses machine learning and analytics to find some repetitive ideas or topics in a series of text documents through a process called “text-mining”. Such a task must be done by a specialist who knows the topic to discern meaningful or logical ideas (Block, 2006).

According to the software developer Enderle (2017), a topic model is a

Simplified representation of a collection of documents. Topic modeling software identifies words with topic labels, such that words that often show up in the same document are more likely to receive the same label. It can identify common subjects in a collection of documents clusters of words that have similar meanings and associations and discourse trends over time and across geographical boundaries.

Some bibliometric companies try to emulate this process by using their software to ease the gathering and analyzing of information. Reference management tools provide aid for different purposes in research and writing. Take, for example, Clarivate Analytics (2021) which provides a wide range of services to collect (Web of Science[®]), order (Endnote[®]), analyze (Reference summary[®]) and cite (Cite while you write[®]) references while using the word processor.

The objective of this paper is to find new trends in the literature using machine learning and reference management systems within the theme of the Internationalization of Small and Medium Enterprises (SMEs). The process includes collecting and analyzing

publications through Endnote® (Analytics, 2021) and topic modeling using MALLET software (Enderle, 2017).

2. METHODS

2.1. Topic Modeling

The collection of the latest articles about “Internationalization of SMEs” was done using web databases of academic literature. Search engines were used, including Google Scholar, Elsevier, Web of Knowledge, SCOPUS, EBSCO, and Science Direct. The search parameters were “Internationalization of SMEs”. A first exploration displayed hundreds of documents. A second exploration was needed to assure that the maximum of documents, applying different terminologies, using the British variation of “Internationalisation of SMEs”, and selecting documents “Internationalization” plus suffix “small” “medium” and “firms” on their titles. The first filter selected only documents in the Management Sciences field. The second criterium is that those articles should be from the last 10 years (2002–2021). The final selection consisted of 857 documents.

Considering the relevance to the topic and the number of citations, the upper 10% of the most cited documents according to the web of science (Analytics, 2021) were selected from the original database. The next step following the guide for topic modeling (Enderle, 2017) is to convert the pdf into text files to run the software. 85 abstracts of the selected papers were collected individually and transformed in the right format according to the developer or standard text file (.txt), usually a document that contains simple text and can be opened in programs like Microsoft Notepad® or Apple TextEdit®. All the files are in lowercase letters, to standardize the words and be able to identify them from the human labeling titles (in capital letters).

2.2. MALLET Commands

- Select the input folder of 85 text files;
- Choose the folder to output the results;
- The output settings included the number of topics 50, with 1000 iterations and 20 words on each cluster.

The articles and pronouns i.e., a, an, the, with, him, her, etc., were filtered out since those are very common words in the English language and might mislead the results.

After MALLET produced topic clusters, they were interpreted. The final analysis was shortlisted into 10 clusters according to relevance to the literature and translated into titles with a brief explanation of their relation/congruence with Internationalization theories.

2.3. Subject bibliography

As a matter of comparison, a second analysis was done, “*Subject Bibliography*” of Endnote® (Analytics, 2021), which attempts to identify the most common words or phrases in a library. The same database of 857 papers was used for the topic modeling exercise. Those articles were part of a reference library saved on Endnote® X9. Each reference contains information that can be included during the analysis. There are two variables to consider: Keywords and Titles, the software produced interconnected keywords. Furthermore, the results were contrasted against the topic modeling outcomes of the MALLET tool and discussed their importance in the field.

3. FINDINGS

3.1. Topic Identification

While the number of outputs was specified by MALLEET, the topic-model tool determined the content of each topic without human interaction. The software produced an output of 50 topics with 20 words each. Randomly, these variables were changed to see if the outcome differs significantly. No significant variations were detected. MALLEET produced a series of topics using keywords from the abstracts that might be clustered according to the probability that they come up together. By looking at the top 10 to 15 keywords, a scholar can catalog those according to their relevance within the Internationalization of SMEs study.

As a result of the first analysis, out of the initial 50 topics, a shortlist of 10 topics was chosen according to their relevance to the literature. Later, those clusters of words were translated into titles with some brief explanations of their importance/congruence with Internationalization theories and references that support those topics.

3.2. Results and analysis of topics

It is important to show what kind of word clusters can be generated when using machine learning. The following paragraphs will show some ideas developed from ten chosen lists of topics/words (*italics*) produced by the topic model tool. After a careful analysis, each cluster is titled (CAPITAL) from research areas, views, and methodologies, that are supported by a literature review. A brief discussion on the importance of these titles is provided after each title.

The order of the selected clusters of words was considered randomly and not according to their value. During this stage, the academic and theoretical value must be evaluated according to the prior knowledge of the evaluator (Block, 2006).

INTERNATIONALIZATION OF SMALL FIRMS AND THE RESOURCE-BASED VIEW

3 | *based* | *resource* | *dynamic* | *concept* | *international* | *provide* | *theories* | *shed prescriptions* | *increasingly* | *basic* | *activity* | *make* | *small* | *upgrade*

The resource-based view theory was developed by Barney (1991) from the philosophies of Wernerfelt (1984) and has been linked with the topic of internationalization (Chung, Ding, Ma, 2019; Kahiya, 2018). The theory assumes that firms need and possess resources and are distributed heterogeneously. The way that organizations utilize those resources to perform better is what separates successful firms from mediocre ones (Gupta, Malhotra, Czinkota, Foroudi, 2016; Szerb, Ulbert, 2009).

DYNAMIC CAPABILITIES THEORY TO SUSTAIN COMPETITIVENESS

6 | *capabilities* | *dynamic* | *main* | *contingent* | *output* | *sustain* | *competitiveness* | *rival* | *ten* | *nurtured* | *incomplete* | *exhibit* | *disruption* | *contingency*

The Dynamic capabilities theory is trending nowadays as part of the Resources-based theory (Santos-Arteaga, Torrecillas, Tavana, 2019; Kim, 2018). The theory developed by Teece, Pisano, and Shuen (1997) explains how organizations use specific capabilities to sense, seize and identify threats or contingencies from rivals (Teece, 2007; Eisenhardt, Martin, 2000).

NEW MARKET ENTRANTS AND THEIR RELATIONSHIP WITH INTANGIBLE RESOURCES OF SMES

9 | *business* | *resources* | *marketing* | *relationships* | *red exchange* | *managerial* | *identifies* | *emerged* | *economics* | *goods* | *intangible* | *entrants* | *unclear* | *explorative* | *multiple* |

The mode of how new entrants explore foreign markets is a topic discussed widely in the past years (Surdu, Mellahi, 2016). Among the two theories of SMEs' internalization, the first one promotes a gradual process of the firm acquiring knowledge to exploit it later (Dow, Liesch, Welch, 2018) or the so-called Uppsala Model (Johanson, Vahlne, 1977). The second one is the Born-global theory which assumes that international organizations gather the necessary knowledge and resources to venture abroad sharply (Knight, Cavusgil, 2004).

THE ENTREPRENEURSHIP RESOURCES BOTTLENECK APPROACH TO INCREASE COMPETITIVITY IN SMEs

14 | *institutional* | *systems* | *entrepreneurship* | *national* | *outcomes* | *approach* | *individual* | *opportunity* | *SMEs* | *specific* | *action* | *types* | *institutions* | *country* | *exist* | *bottleneck* | *methodology* | *introduce* |

The highly cited paper "*National Systems of Entrepreneurship*" (Acs, Autio, Szerb, 2014), with an average yearly citation index of 30.0 (Analytics, 2021), brings to the table a method of ten pillars to quantify Entrepreneurship, with the Internationalization as one of those pillars (Acs, Szerb, 2007).

INTERNATIONALIZATION OF FIRMS IN EMERGING ECONOMIES

16 | *emerging* | *economies* | *strategies* | *theoretical* | *perspectives* | *explained* | *investigates* | *strategy* | *ideas* | *forum* | *primary* | *liberalization* | *settings* | *America* | *Latin* | *derived* | *vulnerable* |

From a first look, it appears that many of the articles on the analysis are related to emerging economies. There is a rising interest to study the internationalization of SMEs in developing countries like China, India, Singapore, India, Taiwan, Brazil, Chile, and Mexico (Chung et al., 2019; Nguyen, Le, 2019).

DETERMINANTS FOR INTERNATIONALIZATION ON SMES

23 | *exports* | *order* | *suggest* | *diversified* | *internalization* | *insights* | *trade* | *determinant* | *presence* | *contained* | *smes* | *channel* | *antecedent* |

The assessment of the level of international involvement for SMEs is also known as the degree of internationalization (Gulanowski, Papadopoulos, Plante, 2018; Banno, Piscitello, Varum, 2015). One way to measure it is through the level of export performance (Boehe, Jimenez, 2018; Kiss, Fernhaber, McDougall-Covin, 2017).

INTERNATIONAL AMBIDEXTERITY. EXPLORATION AND EXPLOITATION OF CAPABILITIES

28 | *capability* | *building* | *exploitation* | *mode* | *process* | *organizational* | *mne* | *role* | *local* | *managers* | *analysis* | *networks* | *external* | *threats* | *quality* | *interactions* | *coordinated* | *organization*

The original paper of March (1991) proposed the idea that managers should have ambidexterity skills. O'Reilly 3rd and Tushman (2004) made the topic popular when the Harvard Business Review published it. The theory implies that to have successful firms the leader should be able to explore new markets and exploit them while being aware of the risks and challenges that involve competing in foreign locations (Jimenez, Boehe, 2018; Vahlne, Jonsson, 2017).

THE ICTS LIKE A CRITICAL SUCCESS FACTOR TO IMPROVE DEVELOPMENT

38 | *group* | *higher* | *factor* | *reference* | *developed* | *contributions* | *scale* | *csf* | *notion* | *article* | *relevant* | *superior* | *focal* | *states* | *icts* | *converge* | *terms* | *profit* | *run*

Some factors endorse success in firms, while others are related directly to the entrepreneur's capabilities (Bai, Holmstrom-Lind, Johanson, 2018; Lopez, Torres, 2017), also known as critical success factors (CSF). Information and communication tools (ICTs) promote new networks and strategic alliances in international markets (Hui, Leong, 2016).

CHINESE FIRMS AND THEIR EARLIER ACCESS TO NEW MARKETS

40 | *development* | *countries* | *empirical* | *economic* | *examines* | *review* | *process* | *question* | *future* | *growth* | *addition* | *included* | *exists* | *reserved* | *contribution* | *Chinese* | *earlier* | *firms* | *taking* | *type*

China has become important in the global markets (Li, Ding, 2013). This economic blizzard has dragged SMEs and lots of research to be conducted at Orient latitudes. Many of the papers discussed the effects of internationalization on China, and how it affects the regions or the process of development of the country (Qiao, Fung, Ju, 2013).

ENTREPRENEURIAL ORIENTATION. INTERNATIONALIZATION PERFORMANCE OF SMES

50 | *performance* | *entrepreneurial* | *orientation* | *internationalization* | *SMEs* | *direct* | *survey* | *suggest* | *network* | *influenced* | *businesses* | *tech* | *financial* | *remain* | *ethics* | *to change* | *observed* | *green*

Many publications recognize the importance of the entrepreneur in the process of Internationalization. International Entrepreneurship (IE) was defined by (Oviatt & McDougall, 2005) as "*the discovery, enactment, evaluation, and exploitation of opportunities across national borders to create future goods and services*" and the second school of thought assumes that Entrepreneurial Orientation (EO) is more related with Corporate Entrepreneurship than with SMEs (Covin, Miller, 2014).

3.3. Keywords analysis with Endnote

The second part of this research had the objective of contrasting and finding connections with MALLET analysis. The study was performed using the subject bibliography tool of Endnote® X9. Table 1 shows the ten most common keywords and their relationship with specific topics. Performance, Internationalization, and SMEs are the most interrelated terms, which is congruent with the research since all papers in the cluster are part of the original web search and validate the topic modeling obtained from MALLET that all topics should be related to that theme.

Table 1. The most intertwined keywords or phrases related to the field

Keyword or phrase	Topic relationship	Repetitions
Performance	Export, Internationalization	49
Internationalization	SMEs, Resource-Based View (RBV), Barriers, Challenges	39
SMEs	Export, Internationalization, Performance, Entrepreneurship, born global firms, foreign markets, developing countries	37
Innovation	Entrepreneurship, Research and Development (R&D) SMEs, Export strategy, Dynamic capabilities	30
Export Performance	Internationalization, Competitive Strategies, Entrepreneurship, Marketing strategies, SMEs, Innovation, Determinants	24
Knowledge	SMEs, Export performance, Management skills, Motivation, Learning, RBV, Intangible assets	21
Emerging Economies	Latin America, China, Internationalization, Exports, Innovation, Dynamic capabilities, Strategy	20
Dynamic capabilities	Knowledge management, SMEs, Innovation, Internationalization, Export behavior, International ambidexterity	18
Resourced-Based View	Internationalization, Pillars, Global Entrepreneurship Monitor (GEM), Entrepreneurship, International ambidexterity, Competitive Performance, Exporting literature	18
Perspective	Internationalization, SMEs, Exporting, Foreign markets, Innovation, International Networks	15
Firm Performance	Dynamic capabilities, Export, Internationalization, Entrepreneurship, Manager Orientation, Social Networks, Information and Communication Technologies	12
Competitive Advantage	SMEs, Exports, Dynamic Capabilities, Innovation, Export Barriers, Capabilities and strategy, Government policies	11

Own source. Developed using of *Subject bibliography* of Endnote® X9 (Analytics, 2021).

Some other frequent keywords were: Entrepreneurial orientation, Strategy, Ambidexterity, Firms Capabilities, R&D, International Entrepreneurship, Foreign direct investment, determinants to export, Internationalization process, Absorptive-capacity,

Impact, Market Orientation, Market Entry, Networks, accelerated internationalization, Born Global, Latin America, Corporate Governance, among many more.

The keywords Performance, Internationalization, and SMEs are widely used, and this result was expected since all documents of the sample (857) were on this topic. The keywords Innovation, Export performance, and Knowledge are gaining more traction in the last decade to explain the Internationalization process.

Likewise, it was remarkable to find in the analysis, similarities with MALLET in phrases like Emerging Economies, Ambidexterity, Dynamic Capabilities, and Resource-Based View. Such terms might have become more popular among researchers on Internationalization. Future research might find them a fertile field to consider. Figure 1 shows a graphical interpretation of the most common words and their association with the main topics found in MALLET.



Figure 1. Relationship of popular keywords and topic analysis
Own source using data from (Analytics, 2021).

4. CONCLUSION

The objective of this paper was to find new trends in the literature using machine learning (MALLET) and reference management system (Endnote®) within the theme of the Internationalization of SMEs.

Importantly, several topics of research interest in the field are standing out: Resources-based Theory, Dynamics Capabilities, and Ambidexterity soon will be taken into consideration and thrive for researchers.

The systems produced insightful results; however, both approaches have room for improvement. MALLET's findings are somehow circumstantial, because the interpretations of the clusters of words may change depending on the person who analyzes them. It is recommended to use experts in the field to read and translate the outcomes into meaningful information. MALLET needs to improve its graphics interface to be more user-friendly and introduce visual graphics. Endnote® seems to have a higher level of sophistication, but the price of the tool is its disadvantage, besides, it works better with papers in its journal's database. Even though some researchers and librarians find Endnote® as a great resource for academic research, especially for systematic reviews (Gotschall, 2021). There are some disadvantages. For first-time users the software is not intuitive, it requires hours of practice and sometimes technical support. All in all, this research phase might get easier with the use of knowledge management software.

To conclude, both, open-source and paid software produce comparable results. Hence, researchers should be encouraged to use machine learning and similar tools to improve their work.

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