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Discovering Knowledge Landscapes: An Epistemic Analysis of Business and Management Field in Malaysia

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Abstract

Identification of topics that are in trend is of immense assistance to industry and governmental institutions when allotting research resources. For researchers these provide a mechanism to understand the structure and dynamics of knowledge domains. Most of the earlier studies to understand knowledge landscapes have been fragmented, concentrating mainly on co-word analyses. In this study we carry out three-dimensional epistemic analyses involving frequency analysis, social network analysis and Kleinberg Burst analysis to get a more diverse and richer picture of knowledge landscape in Business and Management field in Malaysia. We harvested all 209 papers appearing from 1980 to 2010 in SSCI database Web of Science in Business and Management field with at least one of the authors on each paper having a Malaysian address. Our study found that 'Malaysia' has been a hot topic of research for most Malaysian researchers. Knowledge landscape showing interlink between research topics was visualized using Harel-Koren Fast Multiscale spring algorithm. Management topics such as 'TQM' and 'Quality Management' had increased interest from researchers between 2007 and 2008, which is in sync with Malaysian government's increased thrust during this period to promote SMEs under the Ninth Malaysia Plan (9MP).

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1. Introduction

Analysis and Visualization of knowledge domains have gained increased interest among researchers, industry and government institutions. Scientific areas go through surges and slides, some research areas gain importance while others lose importance. Utilizing power of human vision of spatial cognition, maps that are drawn provide meaning to otherwise loads of disorganized textual data (Mane & Börner, 2004). Interest in certain topics of research could be related to several factors, such as government thrust in some knowledge areas by way of research funding, new development in certain topics which are gaining international or local importance, among others.

Most of the earlier works to knowledge discovery have concentrated on frequency analysis and co-word analysis. In Frequency analysis, the keywords are counted and those with highest frequency are then considered to be prominent areas of research. Co-word goes a step further by viewing which topics are related to one another in a research field. General understanding prevails that if similar words are found in multiple documents, they signify the similarity of the research areas. As the words tend to be positioned closer together in the semantic space (Lancia, 2005), it helps in the discovery of hot research topics in the field. Callon et al (1986) carried out some of the earliest works on co-word analysis. Since then numerous co-word analyses have been done to gauge the intellectual landscape of a field (for a review - He, 1999).

A social network is an umbrella term that visualizes connection between entities. Entities are called as nodes and relationship between them (known as edges) is expressed by drawing a line between the nodes. Social Network Analysis (SNA) (Wasserman & Faust, 1994), a set of mathematical algorithms used to map and analyze relationship between entities, is used to examine topics that have remained in research prominence. Here we construct a network based on word co-occurrence and then analyze it further using Social network analysis. A co-word network could be constructed by linking two keywords (nodes) if they exist in the same paper together (edge). We then go a step further to know the topics that have shown increased interest over a period of time and then either faded or continue to remain in prominence.

The aim of this study is to uncover topics that have been of interest to the researchers in Malaysia in the field of Business and Management (BM), by doing three dimensional analyses – Frequency analysis, Network Analysis and Burst Analysis.

2. Material and Methods

Data was harvested from Web of Science for a time window from 1980 to 2010 (30 years), for records in which one or more author(s) had affiliation to a Malaysian institution. Records characterized as ‘articles’ (research papers) were only considered for this analysis. Majority of the papers extracted had authors with Malaysian institution affiliation as the first author, signifying that these authors have been in the ‘driver’s seat’ in most of the research conducted within this dataset.

We take into account keywords provided by the authors (Original Keywords) and Keywords Plus keywords provided by Thomson Reuters using a specific algorithm meant for this purpose. Epistemic Analysis is carried out using Social Network Analysis, counting the frequency of words appearing in the documents and Burst Analysis.

Word Co-occurrence network was first constructed using Sci2 (Sci2, 2009). The software constructs a connection between two keywords if they are found in the same document. Several such connections form

the network, commonly known as the word co-occurrence network. The file was then saved in *graphml* format and imported into NodeXL (Kumar, 2011; Smith et al., 2009) for analysis and graph drawing. Here we apply 3 centrality measures – viz. Degree, Closeness and Betweenness centralities, 2 prestige metrics – Eigenvector centrality and PageRank, and frequency distribution of topics to get a richer and more diverse picture of knowledge landscape. In a network, degree of a node is the number of direct ties a node has (Otte & Rousseau, 2002). Closeness centrality indicates how close a node is to all other nodes in the network (Otte & Rousseau, 2002). In other words, while degree of a network relates to the direct ties of a node, closeness centrality is a measure of number of indirect ties a node has. Betweenness centrality, measures the extent to which a node lies ‘in-between’ other nodes in the network (Otte & Rousseau, 2002). Eigenvector Centrality assigns higher scores to those nodes that are connected by high-ranking nodes (Lohmann et al., 2010). PageRank is another prestige metrics and a variant of Eigenvector centrality, which uses Google’s PageRank algorithm (Page, Brin, Motwani, & Winograd, 1999) to assign scores to the nodes.

We apply Kleinberg Burst algorithm (Kleinberg, 2003), to understand topic ‘bursts’, or topics that have seen increased interest over a time period.

3. Result and Analysis

Among words that have 3 references and above, ‘Malaysia’, with 46 references, is the most frequently used keyword among the keyword library of 1194 words. It has a degree of 12, meaning it is the word with widest scientific coverage in the BM network. It also ranks top in other centralities (see Table 1 and 2). These figure quantitatively prove that Malaysia has been the most important topic of research in the BM network. Articles with this keyword have featured across a variety of areas – from socio-demographic determinants of gambling in Malaysia to diffusion trajectories of emerging sciences in Malaysian R&D system. There are Malaysia centric studies with part-title such as ‘Evidence from Malaysia’ and ‘Malaysia experience’ and studies that compares Malaysia with other countries. Given the fact that dataset the has at least one Malaysian affiliation (and majority being first authors), it is anticipated that researchers would have a natural interest in their country.

‘Model’ is the third most frequently used word, which indicates that authors are suggesting new models or debating an existing model. Most of the ‘model’ keywords are picked by Keyword Plus (or ISI Keywords), which uses an algorithm to extract terms from titles of cited references in articles with an aim to maximizing the retrieval of important and relevant articles (Garfield & Sher, 1993). Word ‘TQM’ and ‘Total Quality Management’ are also an important management terms which have been frequently researched. The word has a degree of 6 (5th Rank), it ranks 3rd in betweenness centrality – indicating its high bridging nature. TQM serves as an important link topic between other topics in the BM network (see Fig. 3). ‘Total Quality Management & Business Excellence’ is a dedicated journal for TQM where several articles have been written. Another interesting topic is ‘internet’ which has a degree of 4 and a high Betweenness centrality (5th Rank). This indicates that this topic too has been another important ‘bridge’ topic and a topic of interest in the BM network.

Table 1. Centrality measures of top 10 keywords according to the ‘degree’ of connectivity.

Keyword	Degree	Betweenness Centrality	Closeness Centrality
Malaysia	12	197.333	0.028

Keyword	Degree	Betweenness Centrality	Closeness Centrality
Performance	8	96.167	0.023
Model	7	48.500	0.020
Impact	3	2.833	0.016
Tqm	6	65.167	0.022
Perceptions	3	8.500	0.019
Management	1	0.000	0.017
Human Resource Management	2	0.000	0.019
Internet	4	31.500	0.019
Competitive Advantage	3	0.000	0.015

Table 2. Prestige measures and Word frequency of top 10 keywords according to the ‘degree’ of connectivity.

Keyword	Eigenvector Centrality	PageRank	Word Frequency
Malaysia	0.124	4.030	46
Performance	0.080	2.778	26
Model	0.076	2.311	19
Impact	0.044	0.947	14
Tqm	0.079	1.766	9
Perceptions	0.050	1.022	9
Management	0.027	0.435	9
Human Resource Management	0.045	0.731	8
Internet	0.053	1.408	8
Competitive Advantage	0.034	0.909	8

Frequent topics are often interrelated and identifying their inter-relations reveal research thrusts of the field. Such analysis could provide a cognitive map, which integrate disparate field of research (Kostoff, 1993). Word Co-occurrence networks tend to be dense, hence only prominent keywords (those that have appeared often) have been considered for display. For visual examination of word-occurrence we lay the graph using Harel-Koren Fast Multiscale (Koren & Harel, 2004), 2D graph layout algorithm. The resulting graph gives a bird’s eye view of research landscape (Boyack, Klavans, & Börner, 2005) of Business and Management field in Malaysia. Nice web of interactions happening between the various topics provide a map by which we can navigate the knowledge landscape (see Fig 1).

Keyword ‘Malaysia’ has co-occurred with keywords ‘Model’ and ‘Performance’, 10 and 6 times respectively, forming important semantic theme among them. Together with term, ‘impact’ they virtually hold the network of topics together.

We ran Kleinberg Burst algorithm (Kleinberg, 2003) to examine if any topic(s) had any surge of interest during a specific period. This algorithm, instead of using content analysis and time-series modeling, uses infinite state automation which enable us to view bursts as state transitions (Kleinberg, 2003). At gamma 1 and 0.5, we could not track any bursty topic, however, at gamma 0.25, the algorithm

Interestingly there has been no topic burst after 2008, signifying no sudden ‘hot’ area, which is has attracted the interest of researchers.

4. Conclusion

In this study an attempt was made to both analyse and visualize the knowledge landscape of Business and management field in Malaysia using three-dimensional epistemic analyses. The study found that Malaysian BM researchers had major interest on issues relating to ‘Malaysia’, ‘Performance’, ‘TQM’ and ‘Internet’ were some of the important bridging topics, which connected other topics in the Malaysia’s BM knowledge landscape. Although at a low frequency, the study also found that certain topics showed heightened interest by researchers when these topic gained external prominence due to new literature in the field or changes in the government policies.

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