Analysis of Enterprise Systems Post Implementation Literature Using Text Analytics Software

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Abstract. A discourse analysis of titles, abstracts and keywords of 75 articles published in the Web of Science between 2000 and 2015 was conducted in order to a) identify the main key patterns and themes of Enterprise Systems (ES) post implementation in the existing literature, and b) identify potential gaps in the literature. In the process, we discovered that the key themes and patterns in post implementation research were surprisingly similar to the major topics such as upper management support, cost reduction, and integration processes. Interestingly, descriptions of the ES governance process did not discuss the notion of the competency center as a key factor to manage ES in the organizations. We used the textual analytic and visualization software tool, Leximancer, previously shown to produce stable results, (Harwood et al, 2015) as the basis for our discourse analysis.

Keywords: Literature Review, Text Analysis, Leximancer, Post Implementation

1. Introduction

With the advancement of computer-aided lexical analytical tools, text mining approach has become more accessible for researchers and practitioners seeking to identify patterns and themes in text documents (Smith, Humphreys, 2006). Practitioners use the text mining approach to identify patterns in company documents, in verbal interactions between customers and service employees as well as to discover customer preferences as expressed in reviews, comments, and social media. Researchers also utilize the text-mining approach to find patterns and examine the semantic links in published academic research. In research, text mining is applied to the analysis of language-in-use to uncover "situated meaning" (Klein & Truex, 1996).

Software-assisted analysis needs to balance the human ability to infer subtle variations in word, phrase and idiom meanings with the software replicability. On the human element, text analysis seeks to discern meaning contained within the textual data. Yet consistent coding (i.e., the reliability) of the meaning of the text, as represented in different turns of phrase, word synonyms and alternate expressions has long been a concern as identified by early proponents of Content Analysis (Krippendorf, 1980; Andren & Rosengren, 1981). Early textual analysis software aided the analyst mainly in the clerical functions of tagging and recalling text and meanings as identified in a co-identified (machine and analyst) concordance or dictionary. Newer approaches, such as latent semantic analysis, converts words/characters to bit patterns that can be counted and subjected to various statistical analysis to identify a number of metrics beyond the mere existence or frequency of use of a word or phrase. Whatever the underlying analysis, any such tool should provide a transparent model *which can be interpreted by the analyst to efficiently conduct a sense making examination of conceivably vast amounts of text* (Smith & Humphreys, 2006). In our recent work, we selected a software tool called Leximancer because it can *"generate a*

transparent model which can be interpreted by the analyst, so that this person may efficiently conduct a sense making examination of conceivably vast amounts of text (Smith, 2017)."

Several IS studies employing this toolset have recently appeared (Crawford & Hasan, 2006; Debuse & Lawley, 2009; Mindel & Mathiassen, 2015; Ridley & Young, 2012). This paper represents research-in-progress, and we would like to focus on explaining the uses of Leximancer[1] in Post Implementation Phase of Enterprise Systems. More specifically, we want to examine **what are the key patterns and themes of ES post implementation in the existing literature**?

2. Leximancer: presentation of analytical steps

Leximancer is a sophisticated text analytic tool that uses metrics from Bayesian Theory, as well as algorithms from computational linguistics and physics, to extract semantic and relational meaning from collections of documents. As an automated form of content analysis, it replicates manual coding procedures through a series of algorithms and statistical processes (Smith, Grech and Horberry, 2002). Leximancer is used to analyze the frequency of cooccurrences of words within blocks of text, in order to produce a set of inter-related maps of derived semantic concepts and themes (Smith, Humphreys, 2006).

The first step in the Leximancer analysis is to read and input a file of text. In this step, the researcher typically can combine different word variations (e.g., organize, organization, organizing, etc.). The second step is the creation of a document matrix-vector – which is comprised of two elements: words and documents being analyzed (Figure 1). Documents are anything with a "semantic structure" that an analyst seeks to interpret. For example, documents may be abstracts from research papers, blog/Facebook posts, advertising, or tweets.

Word frequency		Documents			
		D1	D2	D3	
	Word 1	1	0	1	
	Word 2	0	1	1	
	..				
	Word N	1	0	1	

Figure 1. Document Matrix

The third step in the Leximancer Analysis is the dimension reduction. The document matrix yields a large vector that needs to be reduced to smaller sets of meaningful concepts.

Several IS studies employing this toolset have recently appeared (Crawford & Hasan, 2006; Debuse & Lawley, 2009; Mindel & Mathiassen, 2015; Ridley & Young, 2012). In Leximancer, concepts are identified via words that are weighted according to how frequently they occur within a two-sentence "chunks" of text containing the focal concept, compared to how frequently they occur elsewhere. Concepts then are clustered into higher-level themes. Themes are comprised of concepts that appear together often in the same chunks of texts. Leximancer provides results in the form of "overall" visual maps, where the analyst can view the concepts, sub-concepts (keywords used in creating a concept), or themes (Figure 2). Once the initial overall map is created, the analyst can change the theme size to

adjust the grouping of concepts on the map. For example, in order to select fewer but broader themes or conversely, to drill down into more detailed themes the analyst has the ability to select the desired level of granularity.

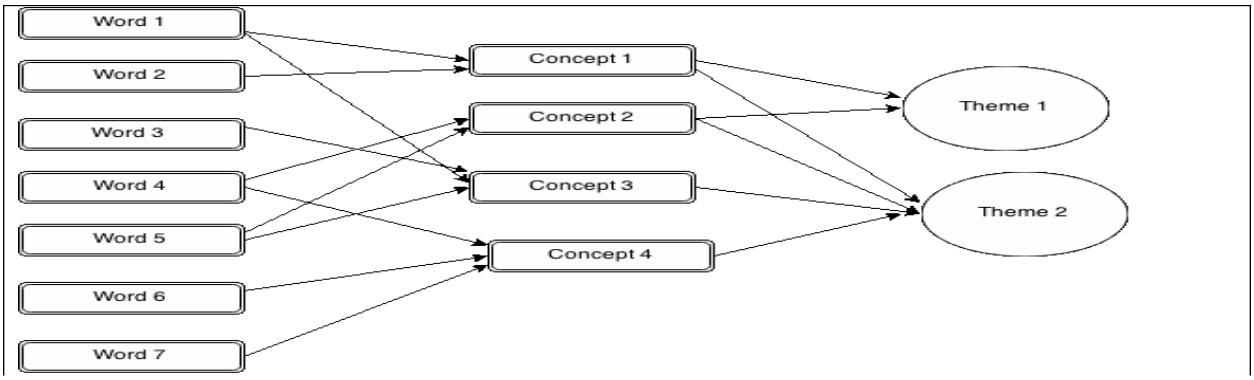

Figure 2. Leximancer processing: transforming words to themes

Leximancer produces visual diagrams, with certain key terms appearing in different-sized circles. Not only is the size of the key term important, but the color of the circle encasing it is important, as well. Specifically, the "hot" colors (hues including red, orange, and yellow) depicts that the theme has a stronger relationship with the concepts (many or similar concepts clustering to make a theme).

The strength of Leximancer is not merely the identification of concept tokens and patterns but lies in the ability to query, retrieve and further drill down into the texts. In the process, it helps in identifying and in excluding from the analysis extraneous terms and false concepts. This is, of course, an iterative and human guided process. The "meaning" is not automatically provided by the software, based on correlation and frequency of words contained in the text. The researcher, like the pilot using fly-by- wire, guided avionics manages the entire research process system-machine and manual- and is responsible for the interpretation and sense-making of these analyses.

3. Research Method: application to ES post-implementation literature

The research conducts a discourse analysis/content analysis of title, abstracts, and keywords of all published articles. The articles were selected by entering the keyword "post implementation" in the Web of Science (WoS) database. Since the results were very inclusive, we further filtered on the "social science" discipline.

The resulting set was narrowed to 126 articles. More than half of the articles retrieved were considering the implementation of hardware and infrastructures in medical and other disciplines. Once we filtered out the hardware and equipment implementation articles, 47 articles remained. These 47 articles are listed in the column named "Search 1" in Table 1. During an initial inspection of these 47 articles, we noticed that some post implementation studies such as Robey et al. (2002), Stefanou (2001) and others were missing from this list. Since these articles did not have the keyword "post implementation", these articles were excluded from the WoS search results. To remedy the problem, we searched for all ES articles by entering the keywords "ERP", "ES", "SAP", and "Enterprise Resource Planning" in the WoS database. Since the search term was very inclusive, we then filtered for "social science" discipline. We filtered out research, principally

published in computer science and operations research journals, dealing with technical issues, such as optimization, minimizing down-times and supply chains and similar operational issues. Essentially what remained were 103 articles. We downloaded all 103 articles and saved into a folder in a computer. We then conducted a full-text search for "post implementation" in that folder. After reviewing the results, we noticed that 28 articles, in addition to the 47 articles identified by the WoS search, discussed some aspect of post implementation. These 28 articles are listed in 'Search 2 Count' column in Table 1. The outcome of this process is that the 75 articles we have analyzed represent a comprehensive set of articles.

Table 1. Articles for Literature Analysis

Abbreviation	Journal Title	Search 1 (WOS C	Search 2 (Cust Count)	Total Cou
DSS	Decision Support Systems	2	NA	2
EIS	Enterprise Information Systems	1	NA	1
EJIS	European Journal of Information Systems	3	NA	3
IJIM	International Journal of Information Management	3	NA	3
IM	Information & Management	3	NA	3
ISJ	Information Systems Journal	3	2	5
ISM	Information Systems Management	2	NA	2
ITP	Information Technology & People	1	NA	1
JAIS	Journal of the Association for Information Systems	2	1	3
JCIS	Journal of Computer Information Systems	1	NA	1
JGITM	Journal of Global Information Technology Management	1	NA	1
JIT	Journal of Information Technology	3	1	4
JMIS	Journal of Management Information Systems	1	1	2
JOCEC	Journal of Organizational Computing and Electronic Commerce	1	NA	1
JSIS	Journal of Strategic Information Systems	1	5	6
MISQ	MIS Quarterly	3	7	10
OTHER	Conference papers, Book Chapters etc.	11	NA	11
Total		**47**	**28**	**75**

4. Content Analysis of ES post-implementation Literature

For each of the aforementioned 103 papers, we created a spreadsheet showing basic bibliographic details of the study: title, author names, journal title, and publication year. We also created a consolidated file of abstract, and keywords of all papers. Next, we excluded common "stop words" (and, not, with, or, etc.) as well as words such as "study", "research" and "results", and instructed

Leximancer, a software for performing content analysis/latent semantic analysis, to merge word variants (e.g., organize, organization, and organizations; also, project, projects, and projected, etc.). Once these parameters for the stop words and merge words were set, we utilized Leximancer to analyze the entire consolidated file, consisting of abstracts, and keywords. Leximancer produced an overall concept map showing what were inside these concepts and how these concepts were related. We then interpreted the overall concept map containing the themes generated by Leximancer.

After removing the common words that appear in almost all studies such as information, system, technology, approach, research, analysis, and others, we re-analyzed the 75 abstracts and obtained the high- level concept map below. The major concepts are discussed in turn.

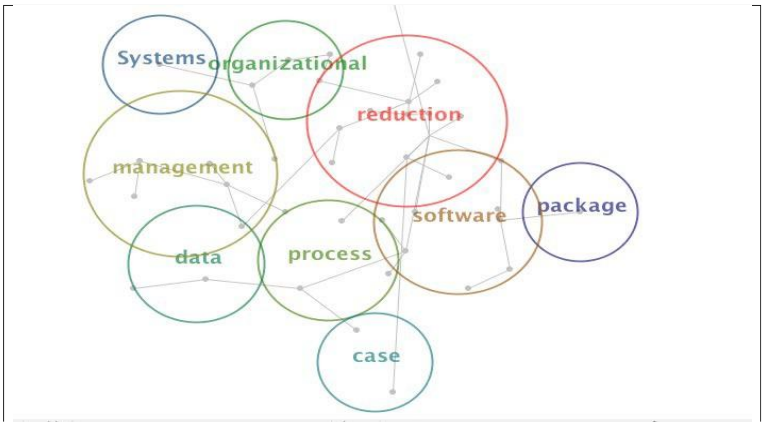

Figure 3. Major Themes in ES Post Implementation Phase

Reduction: It is made up of sub-concepts: Planning, Enterprise, Systems, Implementation, and Project. To examine the relationship between the terms Reduction and its sub-concepts, we performed a "query" function in Leximancer with the combined term, i.e., Reduction + Planning. Based on the query result, we were able to identify that the concept Reduction was mostly related to planning and managing various risks, such as project risk. The examples of reduction include risk reduction (Tian & Xu, 2015), reduction in control (Ignatiadis & Nandhakumar, 2007), and variability reduction (Cotteleer & Bendoly, 2006).

Management: The concept of Management is made up of sub-concepts of organizational, Project, Support, Process, Control, and Integration. To examine the relationship between the terms Management and its sub- concepts, we performed a "query" function in Leximancer with the combined term, i.e., Management + Project. Based on the query result, the concept Management can be classified into the following three categories:

a. Management referring to Top Management, Senior Management
b. Management of resources as in material management, project management
c. A generic term, such as information management, organizational management

Concerning the top management, various studies provided insights on top Management support leading to successful implementations (Akkermans & van Helden, 2002; Hirt & Swanson, 1999; Howcroft, Newell, & Wagner, 2004; Lam, 2005; Newman & Zhao, 2008; Ross, 1999). One of the ways management increases the chance of ES success is by providing intrinsic motivations for users (Ke & Wei, 2008). The top management needs to be aware that the ES users are not homogeneous, and need to develop specific strategies for these disparate groups to have greater user acceptance (Klaus & Blanton, 2010). Managing the post implementation phase by

systematically planning for the maintenance of ESs also requires top management involvement (Ng & Gable 2010) and developing knowledge management competencies (Sedera & Gable, 2010).

Process: The Leximancer identified concept, 'Process', is made up of sub-concepts of Business, Data, Software, Work, and Innovation. To examine this relationship between concept and sub-concepts, we performed a "query" function in Leximancer with the combined term, i.e., Process + Business and others. Based on the query result, we were able to associate the concept of Process to the three main categories of processes: process theory, implementation process, and integration process.

Process theory: The studies belonging to this concept deal with the theoretical aspects of processes, such as work processes, social and behavioral processes rather than the ERP process (such as selection, implementation, and post implementation). These papers often focus on *process models* (Newman & Zhao, 2008; Robey, Ross, & Boudreau, 2002; Uwizeyemungu & Raymond, 2009) or emergent theory frameworks (Gosain, 2004) to examine the post implementation ESs. The second set of research focused on ERP is outcome of a social process (Wang, Ying, Jiang, & Klein, 2006), behavioral processes (Al-Mudimigh *et al.* 2001), trust building process (Gefen, 2004), and learning process (Robey et al. 2002).

Implementation process: Organizations start with ERP selection and evaluation processes (Stefanou, 2001) before embarking on the implementation journey. Another critical question an organization seeking to implement ERP needs to answer is when to reengineer business processes? Whether reengineering prior, during or post implementation (Nandhakumar, Rossi, & Talvinen, 2005)? Answers to these questions are not trivial where technology and culture impact the implementation process (Boersma & Kingma, 2005). The change is complex, and conflicts over business strategy hinder business processes (J. C. Lee & Myers, 2004). One way to mitigate the risk caused by change is to communicate clearly about the business process redesign at pre-implementation and the implementation phases (Nandhakumar *et al.,* 2005). These communications assist with internalizing business processes into standard routines (Z. Lee & Lee, 2000).

Integration process: One of the main appeals of the ES is its ability to integrate with other systems to create a unified technology platform. ESs' ability to integrate with other systems depends on the cross functionality fit through the process re-engineering or through the specific choice of ERP modules by organizations (El Amrani, Rowe, & Geffroy-Maronnat, 2006). During the integration, the fit of processes also depends on employee perception. Employee perceptions of work processes are measured via perceived process complexity, perceived process rigidity, and perceived process radicalness during the ES post implementation (Bala & Venkatesh, 2013).

5. Discussion & Conclusion

Relating back to the research question, we find that the main themes emerging from our analysis are reduction, management, and process. The reduction theme is seen as both positive and negative in organization. For example, when organizations seek to reduce uncertainty, the *reduction* theme is positive. Not all controls are positive, for example when dealing with reducing

control i.e., with the ERP systems when stakeholder deemed that they lost control.

The management theme in Post Implementation echoes the themes from ES implementation literature. For example, one of the themes we observed is management support for project success. The notion of upper management support for project success is not novel in post implementation. Similarly, many other concepts within the management themes such as integration process, implementation process appear in previous ES literature as well.

What we did not observe are the specific post implementation issues such as ES upgrade, and integration with Business Intelligence (BI) systems. The organization need more than simply upgrading to new versions, implementing new modules, or customizing the existing system. To accomplish these tasks, in practice, both ERP vendors and implementation partners strongly recommend the creation of an organizational structure to guide and govern the ERP implementation process. Often this requirement is built into the service level agreements and contracts. These structures are typically called "competency centers (CC)."

While the ES literature has provided significant insights into the implementation phase and change management in general (Markus, 2004; Markus, Axline, Petrie, & Tanis, 2000; Robey et al., 2002; Wagner, Newell, & Kay, 2012), our knowledge of how dedicated organizational units such as CC manage ES post implementation is still quite limited. CCs can play an important role in the post implementation by facilitating the management of technical, administrative, and financial parts within the ES, with internal and external stakeholders. Unfortunately, the current research in ES such as BI&A systems mostly focuses more on technical or the statistical analytics and less on how these systems be better managed to achieve business value for organizations.

This research focuses on only the first steps. In this research focused on the post implementation literature published in major IS journals. In other research, we seek to examine the practitioner literature to understand how the CCs are managed in organizations.

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