

An Empirical Research of Factors Affecting Collaborative Decision Making System

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Abstract

This paper studies empirically business intelligence and social network service used to leverage the performance of collaborative decision making. A model is developed and tested empirically to find out meaningful relationships among those variables. This paper examines the current trend of social media within business intelligence, the importance of integrating these types of features within a BI solution, and why organizations should consider this type of functionality within their current decision making infrastructures. The result also shows that social media will increase in relation to use and expand within business related BI use, developing solutions that become easy to use is essential to successful collaborative decision making adoption.

Keywords: *Collaborative decision making (CDM), Social media intelligence (SMI), Social business intelligence (SBI)*

1. Introduction

In May, 2011, Gartner Group--- the world's leading information technology paper and advisory company gave their prediction to the world: Business Intelligence (BI) + social networking = decision support software 2.0. Although this mathematical equation points out the future's direction of business intelligence development, it fails to take into account of the factors that could affect BI and social network. Further, the Gartner group does not finger out that social network is a part of social media, and social media can do much more than social network in business fields. For companies using BI software, it is more important to explore the potential of their BI system, more closely link with the users at a relatively low cost and lead to a qualitative change to keep competitive in future business. Based on this point of view, some relatively new variables are used to describe a research model because in worldwide competition environment, traditional decision-making approaches no longer meet the requirements of organizations for decision making; organizations must make good use of electronic information system tools such as business intelligence (BI) systems to quickly acquire desirable information from huge volume of data to reduce the time and increase the efficiency of decision-making procedure. Despite the huge operational and managerial advantages of BI systems, many companies face problems in the completely utilization of these tools, therefore, to reduce risk of failure in utilization and also to measure the amount of realized benefits of BI tool defining and choosing the most proper performance measurement criteria and technique is an important issue. This paper tries to give a practical framework based on appropriate social media intelligence utilization and social BI utilization to evaluate the effect of their integration and how they affect the CDM performance.

2. Related Literature Reviews

Information quality can be described as how well the data is structured to addresses business and analysis needs. Poor information is not recognized, and causes incorrect business decisions. Poor information is difficult to be repaired. Modern BI systems, which rely on direct entry of disciplined data, are nearly impossible analyze undisciplined date. Problems with data structures may lead to system collapse. So we should consider information quality when we evaluate both social BI and social media intelligence utilization. Because self-service BI users don't have to rely on IT team to gain access to data and create reports, the decision-making process in companies can become that much faster. Another benefit of self-service business intelligence: it frees up IT personnel to work once again on the larger picture, rather than getting bogged down in the reporting needs of business users.

With the continued adoption of collaboration software in the enterprise, it is starting to do the same in their professional lives, letting workers share documents and brainstorm new ideas. The frontier for collaboration software is its convergence with business intelligence (BI) applications. Web 2.0 tools like blogs and wikis, vendors and industry analysts agree, have dramatically expanded the reach and effectiveness of BI and data analytics throughout the enterprise. Giving workers the ability to easily share and interact with BI reports and analytics is benefit or company. Vendors like SAP and Microsoft say embedding interactive business intelligence reports and ad hoc query capabilities into collaboration software will increase the speed of decision making and make the decision-making. When evaluating BI systems, we should be aware that community collaboration plays an important role.

Social media intelligence has significantly changed the way brands and marketers leverage social media for business. The constant stream of mentions on sites like Facebook, Twitter and blogs provide a great way for companies to monitor their brands, products, and consumers in social media. While monitoring has been useful primarily in customer service and buzz-tracking, there is far more value to be realized. Social media intelligence is the combination of quantitative and qualitative insights gained from monitoring a specific brand, product, or subject matter in social media all in real-time. Social media is the world's largest focus group with millions of participants sharing their unbiased thoughts each day. With this massive data set, businesses now have the power to mine and further understand consumer opinion and slice and dice data by gender, age segmentation and location.

Table 1. Definition of Variables and Measurements

<i>Variable</i>	<i>Measurement items</i>	<i>Definition</i>
Information Quality	1Relevancy 2Timeliness 3Accessibility 4Accuracy	Fitness for use of the information provided
Community Collaboration	1Application sharing 2Elimination of information silos 3Interdisciplinary brainstorming 4Social discovery	Exceptional values and optimized applications in social media communities
Self-service Support	1Recommendation 2Direct transactions 3Educating 4Service recovery	Degree of helping users help themselves
Social Media Intelligence Utilization	1User understanding 2Display targeting 3Visual management 4Inspiration	Degree of Quantitative and qualitative insights gained from social media

Social Business Intelligence Utilization	1Information integration 2Big data analysis 3Convergence capability 4Simplicity	Degree of Social media data analysis for business use
Collaborative Decision Making Performance	1Promptness 2Low expense 3Feasibility 4Satisfaction	Performance of social software and business intelligence's Combination for decision making

Social business intelligence is about bringing more collaboration into users' BI experience. Traditionally, BI has been about reporting, dashboards and ad hoc queries, and it's been about the ability to track key business performance and metrics. Traditional BI has been focused on delivering intelligence from data warehouses and other databases, rather than directly from the other users. Social BI is bringing a collaborative experience into your BI environment, which means that more and more of the BI tools that are available today are allowing users to ask questions of each other and quite often to link those questions to specific reports or visualizations that are presented in their BI environment.

Collaborative decision making (CDM) combines social software with business intelligence. This combination can dramatically improve the quality of decision-making by directly linking the information contained in BI systems with collaborative input gleaned through the use of social software. User organizations could cobble together such a system with existing social software, BI platforms and basic tagging functionality, and it will be far more efficient when software suppliers deliver 'out of the box' CDM solution. CDM is an emerging component of many application types including BI, HR, talent management and suites, but it is also a behavior brought about by the use of Web 2.0 applications. In the vanguard of this trend is the fact that BI is being built into collaborative, cloud-based applications. That trend has spread to the enterprise, where the same collaborative potential of social platforms is being unleashed within business decision-making, both across the organization and within specific departments, such as HR and marketing. Table 1 shows the variables' definition and measurements.

3. Research Model

The model is an integral construct that is developed to predict the dynamics of CDM system's performance in terms of two antecedents: social media intelligence utilization and social business intelligence utilization. The model shows antecedents affect the formation of social media intelligence utilization and social business intelligence utilization which lead to the CDM system's performance. The social media intelligence utilization and social business intelligence utilization are expected to mediate the CDM performance and the antecedents.

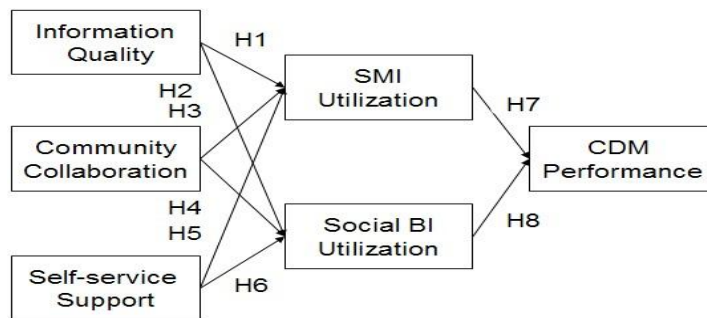


Figure 1. Model of Collaborative Decision Making (CDM) Performance

In information quality construct, relevance can also be interpreted more broadly, referring to generally how good a retrieved result is with regard to the information need. No one wants Giant websites where the piece of information they're looking for is buried deep somewhere within a ton of images and text about unrelated topics and ads that try to lure them into doing things they don't ever want or need. Timeliness means SMI and SBI allow users to quickly identify information's updating and communication's feedback, hence fostering more proactive management of origination, collection, recovery policies and so on. Accessibility is the ability of persons, regardless of ability, to easily access information, regardless of form, structure, or presentation. Accessibility can increase use of systems because people with less powerful computer knowledge may find it preferable to purchase from accessible-friendly websites that require less professional skills. The accuracy of factual information can help users judge the credibility of the author. Accuracy of information can also provide clues to possible bias in the resource under investigation.

In community collaboration construct application sharing means an element of remote access, falling under the collaborative software umbrella that enables two or more users to access a shared application or document from their respective computers simultaneously in real time. Generally, the shared application or document will be running on a host computer, and remote access to the shared content will be provided to other users by the host user.

For self-service support construct, recommendations means to try to help users by delivering a more intelligent and personalized way to seek out new information more quickly and easily. It shares transaction values with provider systems vendors that enhance their software with standard transaction capabilities. This provides latent providers and payers a clear understanding of services. Sometimes the customer service department will instruct its agents to offer additional services or products to their customers after resolving the customer's problems. Educating is the primary function of customer service is to provide education to the customer and help resolve any problems the customer presents, while portraying a positive impression of the company. Service recovery is a good recovery can turn angry and frustrated customers into loyal customers even in cases when there is a systematic failure and the company has control over the failure. There is a benefit when service recovery activities are put into action to ensure that one can win back customers and that the source of failure is eliminated.

For social media intelligence, user understanding means to try to understand people's motivations, their mental models of the world, and the tasks they're trying to accomplish. Consider not just individuals, but groups of people – teams, families and groups of friends and look not just at people, but also at the context in which they live and work. Use ethnographic techniques to observe, question and understand people going about their everyday lives – whether at home or at work. Set observations against a multi-year background of research work and our knowledge of the human sciences. The insights are the basis to improve existing information appliances or inventing new ones. Display and targeting means getting noticed among millions of websites is not an easy task. But putting information in front of an audience who cares about it can help it stand out. Powerful targeting technology puts the information in front of the right people at the right time for the most effective impressions. Visual management means information is visually managed, when there are systems in place that enable anyone to immediately assess the current status of an operation or process at a glance. It translates critical organizational requirements into visual stimuli that can provides a mechanism for continuous improvement through system alignment, goal clarity, engagement of people in the process, and improved communication and information sharing throughout the business progress. Inspiration is social media intelligence' s great advantage rests on balancing the 5Es of education, engagement , entertainment,

empowerment and evangelism. And, at last, great inspiration! Social media is a great way to get people out of the personal block, with so many things being share every second, it gets really easy to find information that matches users niche.

As to Social business intelligence construct, information integration is the merging of information from disparate sources with differing conceptual, contextual and typographical representations. It is used in data mining and consolidation of data from unstructured or semi-structured resources. Typically, information integration is to get a large set of heterogeneous data sources to appear to a user or system as a single, homogeneous data source. Big data analysis refers to the capability of tools, processes and procedures allowing an organization to create, manipulate, and manage very large structured or unstructured data sets and storage facilities in social media and business intelligence. Given the ubiquity of large high-dimensional data sets, and the need not only to transmit, archive, and reduce them, but also to analyze and understand their scientific and/or intelligence content, professionals are developing tools for the computational dissection, analysis and understanding of complex datasets whose size defies simplistic analysis. Convergence capability is the interlinking of business intelligence and other information technologies, media content, and communication networks that has arisen as the result of the evolution and popularization of the Internet as well as the activities, products and services that have emerged in the digital media space. It is as simply being the tip of the iceberg, as all facets of institutional activity and social life such as business, government, art, journalism, health, and education are increasingly being carried out in these digital media spaces across a growing network of information and communication technology devices. Simplicity means common functions of business intelligence technologies such as reporting, online analytical processing, analytics, data mining, process mining, business performance management, benchmarking, text mining and predictive analytic are too complex to users.

For a CDMS, promptness means the time available to complete the decision making process for a specific decision is probably the most important criteria in choosing the most appropriate style. Be careful with this as it is the factor most manipulated to pressure a poor decision. It is desirable to get the positive consequences of a good and effective decision as soon as possible. A higher performance decision will require a more consultative or collaborative decision making style. Feasibility studies aim to objectively and rationally uncover the strengths and weaknesses of the existing business or proposed venture, opportunities and threats as presented by the environment, the resources required to carry through, and ultimately the prospects for success. Satisfaction is the attitude of a user to the CDM system he employs in the context of his/her work environments.

4. Research Method and Analysis Results

A survey is conducted in order to empirically test the research model proposed in the previous section. All study variables and their measurement items are designed to gather perceptions at the individual level, making each individual the unit of analysis. Responses are measured on the 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaires are collected via both the survey web site. The questionnaires are distributed to 462 people including university students from November 19, 2011 to December 7, 2011. In total, 361 respondents returned questionnaires, giving response rate of 78.1%. Excluding questionnaires incompletely or carelessly answered, 341 responded questionnaires are used for data analysis.

Table 2. Results of Confirmatory Factor Analysis

<i>Variable</i>	<i>Standardized Factor Loading</i>	<i>S.E</i>	<i>t Value</i>	<i>C.R</i>	<i>AVE</i>
Information Quality	0.776	0.453	10.556	0.842	0.606
	0.877	0.378	9.698		
	0.825	0.654	9.021		
Community Collaboration	0.766	0.506	11.221	0.947	0.756
	0.735	0.348	14.336		
	0.747	0.298	14.023		
	0.725	0.325	12.855		
Self-service Support	0.727	0.366	19.435	0.972	0.776
	0.731	0.365	19.564		
	0.843	0.306	13.331		
	0.705	0.327	12.321		
Social Media Intelligence Utilization	0.706	0.340	11.332	0.942	0.746
	0.711	0.336	17.656		
	0.713	0.317	18.556		
	0.827	0.341	17.559		
Social Business Intelligence Utilization	0.858	0.415	10.354	0.920	0.695
	0.811	0.374	16.656		
	0.785	0.405	14.565		
	0.812	0.361	15.553		
Collaborative Decision Making Performance	0.777	0.479	12.332	0.816	0.697
	0.775	0.321	8.454		
	0.887	0.299	7.665		
	0.812	0.254	10.212		
	0.801	0.233	7.258		

Results of a confirmatory factor analysis for the entire variables are summarized in [Table 2]. It is confirmed the validity using standardized factor loading values. According to previous researches, the convergent validity exists when factor loading values are greater than 0.6 and statistically significant. Since all factor loading values are above 0.6 and all t-values are above 2.0, the convergent validity of the model is confirmed.

The model is tested using AMOS 18 which is widely used for model fit and path analysis. Table 3 summarizes results of model fit analysis. The goodness –of –fit statistics in the table, in general, support the integrity of the overall model with the data when compared with thresholds values suggested by the literature. The Chi-square statistic, Goodness–of-Fit Index (GFI) and Root Mean Square Residual statistic (RMSR) are absolute indices representing the ability of the model to reproduce the actual covariance matrix. Chi-square statistic (1.642) is small (less than 3.0), implying that the null hypothesis of covariance matrix equality is accepted, indicating good model fit. The overall degree of fit is good, as reflected with a GFI of 0.933, above the recommended values of 0.90. The standardized RMSR characterizes the residual variance of observed variables, as high values suggest high residual variances; small values are better.

Table 3. Summary of Fitness Statistics

<i>Type</i>	<i>Chi-square ratio</i>	<i>GFI</i>	<i>AGFI</i>	<i>NFI</i>	<i>TLI</i>	<i>CFI</i>	<i>RMR</i>
<i>Threshold</i>	<3	>0.90	>0.80	>0.90	>0.90	>0.90	<0.05
<i>Value</i>	1.642	0.933	0.915	0.927	0.963	0.964	0.042

Related formulas are listed below:

$$NFI = \left[X^2_{(NULLMODEL)} - X^2_{(PROPOSEDMODEL)} \right] / \left[X^2_{(NULLMODEL)} \right]$$

$$CFI = \left[d_{(NULLMODEL)} - d_{(PROPOSEDMODEL)} \right] / \left[d_{(NULLMODEL)} \right]$$

$$TFI = \left[X^2_{NULL} / df_{NULL} - X^2_{MODEL} / df_{MODEL} \right] / \left(X^2_{NULL} / df_{NULL} - 1 \right)$$

$$IFI = \left[X^2_{NULL} - X^2_{MODEL} \right] / \left(X^2_{NULL} - df_{MODEL} \right)$$

$$GFI = 1 - \left\{ TR \left[W^{-1/2} \left(S - \hat{\Sigma} \right) W^{-1/2} \right] \left[W^{-1/2} \left(S - \hat{\Sigma} \right) W^{-1/2} \right] \right\} / \left\{ TR \left[W^{-1/2} S W^{-1/2} \right] \left[W^{-1/2} S W^{-1/2} \right] \right\}$$

$$AGFI = 1 - \left\{ \left(1 - GFI \right) \left[q \left(q + 1 \right) / df \right] \right\}$$

5. Results of Path Analysis

The path between SMI utilization and CDM performance, social BI utilization and CDM performance, information quality and SMI utilization, community collaboration and SMI utilization, self-service support and SMI utilization, information quality and social BI utilization, community collaboration and social BI utilization are significant at $p=0.001$, $P=0.01$ or $p=0.05$ and the path between self-service support and SMI utilization is not significant at $p=0.05$.

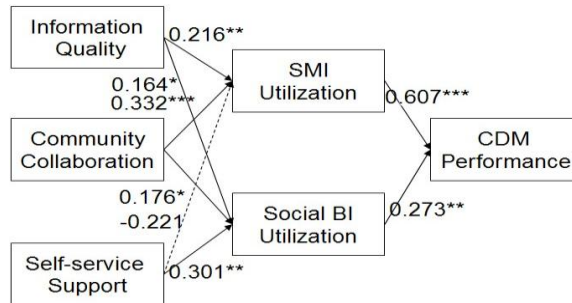


Figure 2. Results of Path Analysis ($p < 0.001$ ** $p < 0.01$ * $p < 0.05$)**

Information quality had relatively similar impacts on both SMI utilization and social BI utilization, which values are 0.216 and 0.164. Community collaboration also had meaningful impacts on SMI utilization and social BI utilization, which values are 0.332 and 0.176. Self-service support had impacts on social BI utilization (0.199) but has no impacts on SMI utilization (-0.221). SMI utilization had more impacts on CDM performance (0.607) than social BI utilization did (0.273).

6. Discussion and Conclusion

This paper introduces the basic concept of CDM and empirically studies factors affecting CDM performance in order to help make a proper business model for CDM in the future. This article examines the current trend of social media within business intelligence, the importance of integrating these types of features within a BI solution, and why organizations should consider this type of functionality within their current decision making infrastructures. Since social media will increase in relation to use and expand within business related BI use, developing solutions that become easy to use is essential to successful collaborative decision making adoption. As business intelligence solutions become more robust and expand towards agile delivery models, using social media as part of software offerings will become embedded within overall BI platforms. The features and functions that currently exist in relation to data integration, dashboards, and analytics are robust and provide a good framework for additional functionality that increases the interactivity of business intelligence use. Add this to the rise in social networking and increased interactivity, and BI becomes a tool that not only provides performance management but also helps with increased collaboration and broader adoption.

Our empirical analysis provides validity of the proposed model. It highlights the need to focus on the role of CDM performance when organizations want to gain competition advantage. In addition, this study demonstrates the complexity and the multidimensional nature of the CDM performance construct in business intelligence and social media. SBI and SMI utilization are both found to be significant components for CDM performance. This result helps to advance other researches' interpretation in this area by introducing CDM performance. Many trends emerge over time within the business intelligence market. Recently these have included unstructured data, the data warehouse appliance market, self-service and agile BI, the list goes on. In general, what these trends have in common is the goal of making BI more efficient and more interactive. Social media helps bring these solutions closer to this goal through ease of use and greater levels of collaboration. Within BI specifically, the role of collaboration is growing. Whether organizations want to communicate more effectively with customers or partners, or with colleagues and disparate departments within the organization, social networking platforms increase overall communication.

It's time to take an enterprise approach to managing CDM with a BI and social media. A CDM enables users to bridge organizational silos and deliver all kinds of solutions in support of strategic and tactical objectives. Companies that have created CDM are able to extract more value from BI and social media to unleash new business opportunities, create greater customer value and operate more efficiently. Both social media and BI are about using intelligence and making it available to decision makers. BI may be more established as a discipline, but the potential of adding new social-inspired collaboration capabilities offers to democratize the BI process. This shift in the enterprise intelligence model offers the potential to improve the quality and speed of decisions, while also cultivating analytical to improve the quality and speed of decisions, while also cultivating analytical skills across a broader section of the organization. Meanwhile, BI has models for dealing with structured data and to support fine-grained trust models, both of which social media needs to adopt if it is necessary to realize the promise of CDM – where social media intelligence is fully and strategically integrated into an organizations and individuals' daily CDM applications and business processes.

The strengths of BI and social media complement the weakness of the other. The paper suggests that blending BI and social media models properly can improve the CDM greatly. However, it is believed this blending must go deeper than tools based decision making;

adding simple BI and social media utilization in CDM can make a lot of solutions and make the process seamless.

7. Limitations and Future Research

This study has several limitations and directions that merit further research. The respondents for the survey are Chinese people, and there are not enough CDM systems have been used in Chinese organizations or enterprises. Both social media and business intelligence are new technologies for most of us and it takes time for users to understand those new applications. It is worthwhile to conduct future research by employing a triangulation of data collection methods (such a collecting measures from different sources or countries and different organizations or enterprises) to further validate the research model. However, other factors may also be important for CDM system. For example, the intelligence management is a very important factor in CDM system. Another factor could be intelligence community, which may be considered in future researches.

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