Environmental Scanning and Business Insight Capability:

The Role of Business Analytics and Knowledge Integration

Full paper

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Abstract

Environmental scanning is an important process that helps organizations sense what is happening in their environments. However, environmental scanning has been found to be less effective than its proponents had hoped for. The problem appears to be that environmental scanning does not lead to the business insights that managers need to help their organizations survive and grow. This paper reports a study into the role of data analytics and knowledge management on environmental scanning and business insight capability. Fifteen indepth interviews were conducted with data analytics professionals to get a deeper understanding of how what they did impacted the results of environmental scanning processes and the generation of business insights. The results indicate data analytics and knowledge management need to play a bigger role in the environmental scanning process if greater business insights are to be generated.

Keywords

Environmental scanning, business insight capability, business intelligence, data analytics, and knowledge management**.**

Introduction

Terms like *information explosion* and *data overload* are common in today's business environment. However, despite an abundance of data, the desired data is often difficult to find, and even when such data are acquired, important decisions are often not made efficiently (Dean & Webb, 2011).

Many studies have examined how organizations obtain external data to identify opportunities and threats so they can adjust their strategies to the changing external environment (Yasai-Ardekani & Nystrom, 1996). This process called *environmental scanning* (ES) comprises activities commonly seen as first steps in decision making and future planning (Bourgeois, 1978; Costa, 1995; Choudhury & Sampler, 1997). The famous PEST analysis is a typical environmental scanning process that looks at political (P), economic (E), social (S), and technical (T) elements in an organization's external environment (Ghezzi et al., 2013). The ways in which organizations capture environmental information and improve decision making by utilizing environmental scanning processes are important research topics and essential for firms to gain competitive advantage (Davis, 2008).

Stoffels (1994) identified three pitfalls of ineffective environmental scanning: inadequate analysis, unreliable technology, and lack of focus on decision makers' real needs. As the business environment has gotten increasingly complex, huge information flows are inundating organizations, and many organizations feel the pressures of a lack of analytic capability in the face of too many information sources (Davenport et al., 2012). In response, we see a move toward the utilization of more powerful IT tools to

help decision making. As a result, business analytics (BA) are near the top of the list of major IT investments for many organizations (Chen et al., 2012).

Business analytics (BA) are "a group of approaches, organizational procedures and tools used in combination with one another to gain information, analyze that information, and predict outcomes of problem solutions" (Trkman et al.,2010 p.318, adopted from Bose,2009). BA tools can empower organizations through the generation of business insights, which are deep understandings of given situations that can benefit the business (Vriens & Verhulst, 2008). However, some organizations assume that an insight capability comes automatically with investing in and implementing BA tools. That is not necessarily true. It is relatively easy for managers to get an information dashboard, but it is not as easy for them to get the right information or to synthesize this information to gain helpful insights.

Motivated by the gaps between BA tools implementation and efficient business insight delivery, this study proposed that knowledge integration (KI) capability (an important component of knowledge management (KM)) plays a big role in business insights generation. Recent studies have noted the importance of knowledge management in acquiring BA capability and in improving decision making, and several researchers have called for integrating KM and BA (e.g., Davenport, 2006; Herschel & Jones, 2005; Vinekar et al., 2009). However, there has been relatively little empirical research into how BA and KM/KI can together improve business insight generation.

The purpose of this paper is to explore the impact of business analytics and knowledge integration on an organizations' environmental scanning processes and business insight capabilities. This is done by interviewing a set of individuals directly involved in these processes: business analytics practitioners. A better understanding of how these individuals perceive and enact their roles might help organizations achieve better results from their environmental scanning activities and ideally also generate more business insights.

The paper begins with definitions of the major constructs (BA, KI, and ES). This is followed by a description of dynamic capability theory which is used as the theoretical base for this study. Next, descriptions of the research method and analysis process are provided. This is followed by a description of the findings and propositions. Finally, the contributions and implications are described.

Background and Definitions

Environmental Scanning (ES)

Environmental scanning (ES) provides necessary information for decision making, so it is usually considered among the first steps in the decision-making process (Bourgeois, 1978; Costa, 1995). ES is defined as "scanning for information about events and relationships in a company's outside environment, the knowledge of which would assist top management in its task of charting the company's future course of action" (Aguilar, 1967 p. vii). The primary function of environmental scanning is to collect useful information from the external environment, interpret this information, and establish relationships between this information so that an organization's decision makers can extract implications for decision making and future planning (Costa, 1995; Maier et al., 1997; Stubbart, 1982). Some typical scanning elements are the structure of key competition in the industry, the emergence of new technologies, changes in laws and regulatory guidelines, local, regional, national, and international economies, social changes such as demographic shifts, and local, national, and international politics (Albright, 2004). These environments provide a broad social, economic and political framework within which scanning can be conducted.

Moreover, various patterns of scanning have been studied in the literature. One of the seminal works is Daft and Weick's four quadrants framework (1984), which is modified from Aguilar's (1967)ES pattern (see Figure 1). This framework classified ES patterns into directed viewing, enacting, conditioned viewing, and discovering based on the organization's perception of the analyzability of the environment and the intrusiveness of conducting this analysis.

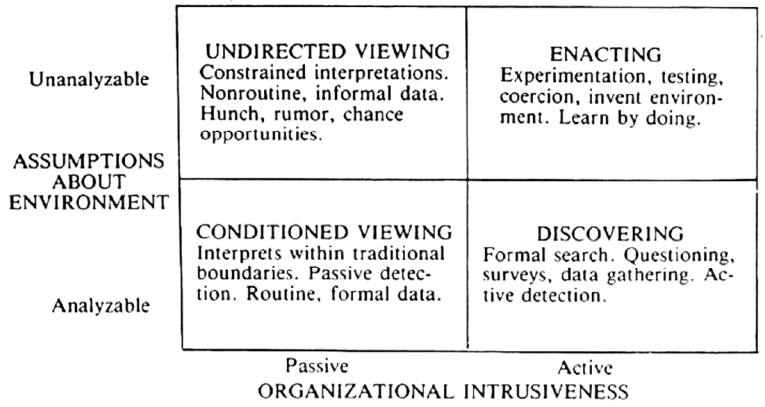

Figure 1. Four types of environmental scanning. Source: Daft and Weick (1984).

The aim of environmental scanning is not merely gathering information but also utilizing the organization's analytic and forecast capabilities to predict future impacts and to aid in planning. The essence is that ES can help organizations quickly adjust in response to a turbulent market, but organizations may not achieve such an advantage if they don't have analytic capability at an equivalent level.

Business Analytics (BA) Capability

The study of BA has a long history and has received widespread attention in recent years. Chen et al. (2012) identified a framework of three eras in the evolution of business analytics, which provides a good overview of BA characteristics and capabilities over time. Seen as the 1.0 era of BA, business analytics were referred to the main analytic components of business intelligence in the 1990s, providing organizations with structured data through various enterprise systems. Since the development and widespread of the Internet, the era of BA 2.0 has witnessed a dramatic development in web-based and unstructured content, giving organizations new business opportunities as well as challenges. Now, in the era of Big Data and the Internet of Things, it is expected that the BA 3.0 will embrace more mobile and sensor-based features (such as internet-enabled RFID). As Chen et al. predicted, moving along through data analytics to web analytics, we are expecting more mobile analytics in BA 3.0 era which are location aware, person-focused, and context-relevant.

So how can we take advantage of BA to gain useful insights? Ferguson et al. (2005) developed an insight evolution model demonstrating that forward-looking companies aim at increasing data gathering and access capabilities while also increasing their ability to convert data into insights. By doing so, the organizations gain specialized and deep analytic knowledge and move from only understanding the past toward predicting the future.

However, no matter how advanced technology is, simply implementing BA tools doesn't bring about business insight. There is necessarily a significant gap between the analytics, either provided by experts or the tools, and real business needs. (Kohavi et al.,2002).

Knowledge Integration (KI) Capability

Based on a survey conducted with more than 3000 business executives in 2011, the top challenge of obtaining business insights was not data quality and quantity, but *a lack of understanding of how to use analytics to improve the business* (LaValle et al., 2011). One of the traditional views of a firm is as a processor of information (Amin & Cohendet, 2004) while its behaviour is an optimal reaction to internal and external signals (information) captured by the firm. Kogut and Zander (1992) suggested that we should view firms as repositories of capabilities because embedded knowledge can determine the relationship structures and organization principles. Fransman (1994) interpreted this as a shift from firms conceived as processors of information to processors of knowledge. Following this logic, the integration of knowledge and the creation of an organizational knowledge base is one of the primary roles of the firm and the essence of building organizational capabilities (Grant 1996).

Integration is the extent to which distinct and interdependent components constitute a unified whole (Barki & Pinsonneault, 2005). Integrating explicit knowledge is relatively easy, because explicit knowledge enjoys the advantage of codifiability, communicability, assimilatiability, and storability (Grant, 1996). Thus, the coordination of explicit knowledge can be supported by the development and use of information technologies. However, the integration of tacit knowledge is more challenging. On the one hand, the codification of tacit knowledge into explicit knowledge involves unavoidable knowledge loss. On the other hand, tacit knowledge is personal, and the "sticky" nature of the tacit knowledge makes the transmission much more difficult as it involves a deep understanding of the embedded context (Hislop, 2002). Thus, tacit knowledge is usually shared through observation and learning by doing. Grant (1996) suggested that organization routines provide mechanisms for knowledge integration that can be independent of communicating knowledge in explicit form. With established organizational routines, individuals can interact under a sequential pattern that allows them to integrate their knowledge without communicating that knowledge explicitly.

Theoretical Background: Dynamic Capability

To address the gaps and shortcomings of resource-based view theory, the original definition of dynamic capabilities (DC) given by Teece et al. (1997) focused on the resource-reconfiguration ability of the organization. By changing the organization's resource mix, dynamic capabilities can provide new alternatives for the firm.

Eisenhardt and Martin (2000) defined DC from a process perspective. In their conception, DC took the form of an organizational process, such as resource allocation routines, knowledge transfer and replication routines, and product development routines. Likewise, Zollo and Winter (2002) refined the definition of DC as "a learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness" (p. 340). This definition focuses on organizational learning as a source for modification of operating routines.

Furthermore, Teece (2007) divided dynamic capability into three parts: sensing and shaping opportunities and threats, seizing opportunities, and maintaining competitiveness through enhancing, combining, protecting, and reconfiguring the enterprise's tangible and intangible assets.

In sum, the foundation of dynamic capability is resource reconfiguration, and all these different definitions provide different attributes and mechanisms for the deployment of dynamic capabilities. Comparatively speaking, the integration of BA and KI capabilities can form an important dynamic capability because they can purposefully extend, create, or modify organizations' information and knowledge resource base and related processing capabilities, which may influence firms' environmental scanning activities.

Method

A case study approach was used and data was collected by interviewing individuals who have practical experience with business analytics and environmental scanning. It was determined that part-time Masters students in graduate business analytics-related programs at a university in eastern Canada were qualified participants. These students held full-time positions in organizations while completing their degrees, and are knowledgeable and have relevant experience in ES and using BA tools. In total, 15 participants were selected creating 15 valid cases. According to Eisenhardt (1989), if most of the cases show the same or similar results, then the preliminary theory that describes the phenomena can be supported. We determined that these 15 cases met the requirements for exhausting new themes that may emerge in the data and established theoretical saturation (Creswell, 2006; Glaser & Strauss, 2009).

One author transcribed and coded each case during the interview process, and an independent coder who is not involved in this research re-coded 15% of the transcripts (two cases) after all the interviews finished. A brief coding guideline and training was given to the second coder based on the coding scheme. The final agreement percentages are high in both of cases: an average of 95.96% and 95.66%, respectively.

Within-Case Analysis

The 15 participants came from different industries and businesses of different sizes, ranging from local start-up consulting firms to multinational retail companies (see detailed case descriptions in Appendix A). All of them perform analytical tasks in their daily work. They rely on huge amounts of data to support further analysis so that valuable business insights can be obtained.

BA Capability

According to Ferguson et al.(2005), two dimensions can be used to reflect BA capability: the ability to gather, store, and access data, and the ability to use data for insight. Figure 2 plots the cases in a four-quadrant diagram. Cases are found in all quadrants, however most of our cases fall within the high-high quadrant. It may be because the participants we interviewed happened to have a higher BA capability than usual. It does not mean the other three quadrants are less likely to occur in practice.

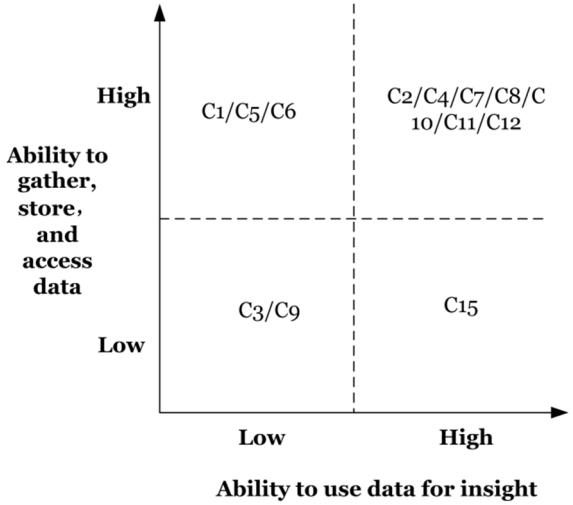

Figure 2. BA capability level of 15 cases

Low ability to gather, store, and access data means that the organization may or may not have professional BA tools, and the employees may lack training or may not trust these tools, so that they are not willing to use the tool. C3 said,

At the beginning, there was a lot of Excel, then it turned into more of an SQL database. . . . [I]t was not sophisticated at all. . . .

In contrast, organizations having high ability usually rely heavily on sophisticated BA tools and have routinized rules to control data gathering and storage.

"We established a routine that (our customer representatives) have to synchronize (the data) at least three times a week. . . . We will not do a PowerPoint presentation. We will take the graphs from the [BA tools] to our presentation," C2 said.

The horizontal axis represents the ability to transform data into insights. From the BA tool function perspective, this ability can be reflected in functional flexibility. Organizations with low data-transformation ability may have a simple and rigid BA infrastructure and functionality that may not fulfill the employees' needs and usage habits, making them unwilling to use these templates and built-in functions.

C8 said, *"I have seen some other tools that I would think are more relevant and easier to use… I didn't find [my tool] actually useful for that. . . . I used to rely a lot of my analysis on Excel."*

However, BA tools cannot generate business insights automatically. Accordingly, the other important element that can influence the ability to transform data into insights is employees' ability to use the tool.

I would say it requires quite a bit of training and hands-on practice. When I was first started exposed to it… I don't think I probably could have learned it without a mentoring and stuff which my secretary did for me…(C4)

C10 also discussed a high level of data transformation ability:

Often, I'd say 99% of the time, we create our own templates. The ability to create our own reports gives us the ability to change as our needs change.

Most of the cases landed in the upper part of Figure 2, with a high ability to gather, store, and access data, and may or may not have had high ability to turn data into insight. The explanation for this may be that ability to gather, store, and access data rely more on the BA infrastructure and employees' ability to use the tools, which are the foundations for transforming data into insight. Thus, if an organization has a low ability to gather, store, and access data, it is less likely that it will have a high capability to generate business insights.

ES Activities

According to Daft and Weick's framework, environmental scanning can be divided into four different patterns: undirected, conditioned, enacting, and discovering. Each case is analyzed by examining each organization's information needs, information seeking, and information use (Figure 3): three characteristics that reflect ES modes (Choo, 2001).

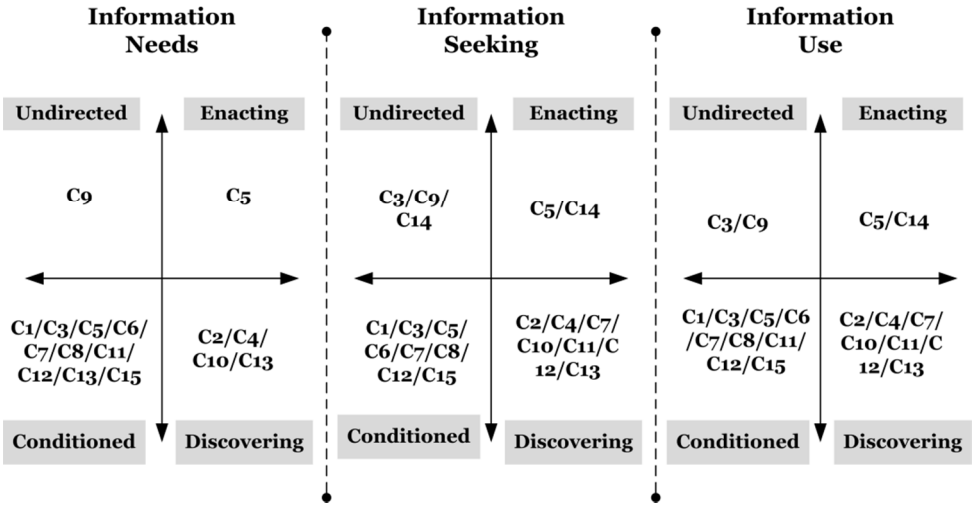

Figure 3. ES activities for 15 cases

Information needs in the *undirected mode* are usually fuzzy and lack a defined information collection procedure. Correspondingly, information seeking is casual and organizations are at risk of being surprised by sudden events. C9 had a typical undirected mode that didn't proactively collect external information:

When there's an actual event that happens, our customers tell us that there's an action that we need to be aware of, and we need to either act on or be prepared to act on it.

This kind of environmental scanning relies much on informal external information exposure, which depends on the intensity of signals that come to the organization's attention. Yet because of the investment of resources, such as personnel, money, and time, is low, this kind of organization could have a relatively low cost of performing ES activities.

Organizations with *enacting ES mode* believe that the external environment is unanalyzable, yet they want to know about what is happening around them. Their ES activities are similar to experiments. This is an interactive process in which the organization tries to test new rules and interpretations of the environment and get feedback.

"We also have a consumer insights and research department that we would work in parallel with to develop this to get an idea from the front lines of our customers or whatever it is to get a better idea as well," C5 said.

Compared with enacting organizations, the information needs of *conditioned ES* firms are usually well defined, but narrowed to their own assumptions about the environment. They usually have standard procedures when seeking information that are quite limited to respected and widely used sources. Almost half of the interviewees reported a conditioned ES mode in their daily work. As C7 stated:

It's regular work. They have the model score every month that allow us to use that external data … and we develop continuous model scores to select customer needs.

The last ES mode is *discovering*. This type of ES has a strong initiative to explore the environment. Discovering organizations usually have broad, open-ended, but well-defined search goals. The information-seeking process involves rigorous and objective procedures, such as formal surveys and market research. In contrast to conditioned ES, discovering organizations have a willingness to update existing information to get new insights. C10 is a financial analyst from a manufacturing organization who said *"I usually use programs that help the marketing department and the strategy team and management to see what areas are growth areas, what customers are high margin customers."*

The discovering mode requires more searching and validation efforts to update the existing knowledge base so that the organization can determine the situation and react to changing events, and this is the major difference from the conditioned and experimenting modes.

KI Capability

Organizational knowledge integration is a matter of organizational commitment to the value of knowledge and employees' willingness and ability to acquire, share, protect, and transform knowledge. Most of the organizations in the interviews do not implement sophisticated IT systems to manage knowledge. The transfer of knowledge largely depends on personal contacts.

Most of them (knowledge) are probably private… Sometimes it would just be informal conversations over dinner.(C3)

Many organizations in the interviews did not have a clear knowledge distribution map by which to locate knowledge and expertise. C15 is a lead analyst for a utility organization. Her organization tried to build transactive memory, but the employees cannot share and locate knowledge easily. She said "*A newer employee will have a harder time getting to know where to go because there's no clear line drawn. "*

All 15 organizations' KI capability levels were coded on a spectrum of low, medium, and high. If an organization had intelligent tools to manage knowledge and organizational culture commits to the value of knowledge and its management, this organization would fall within the high category. If KM were neither practiced nor managed by systematic mechanisms, this organization would fall into the low category.

C4 is a project manager for a world-leading oil and gas company whose KI practice is well constructed. C4 said " *I think it's [the knowledge sharing system] a fantastic tool. You could just go in, and you type something, you're guaranteed to get something on what you're looking for."*

It is clear that this organization has a high level of KI capability. There is an advanced knowledge management system and professional support team behind it. Employees recognize the value of knowledge and are eager to use the KM platform to share and acquire knowledge. Most importantly, KI is embedded in the organizational culture and knowledge workers' routines.

Most of the participants' organizations have a medium level of KM capability. They may or may not have a centralized repository of knowledge. Most of the employees know the value of knowledge, but KI activities are not routinized and rewarded. As a result, the organization may not fully explore the potential of KI, and the employees may not realize the importance of improving their organizations' KM practice.

In summary, organizations with higher BA capability are more likely to have a discovering ES pattern, which means that the external environment is more analyzable to these organizations and employees will explore the environment actively. If an organization has a low BA capability as well as a low KI capability,

it is more likely that this organization believes the external environment to be unanalyzable and purposefully does not search the environment.

Cross-Case Analysis: Exploring the Mechanisms

Based on our analyses, we developed an integrated model of business insight capability that shows the interaction between ES, BA, and KI and their relationships to the generation of business insights (see Figure 4).

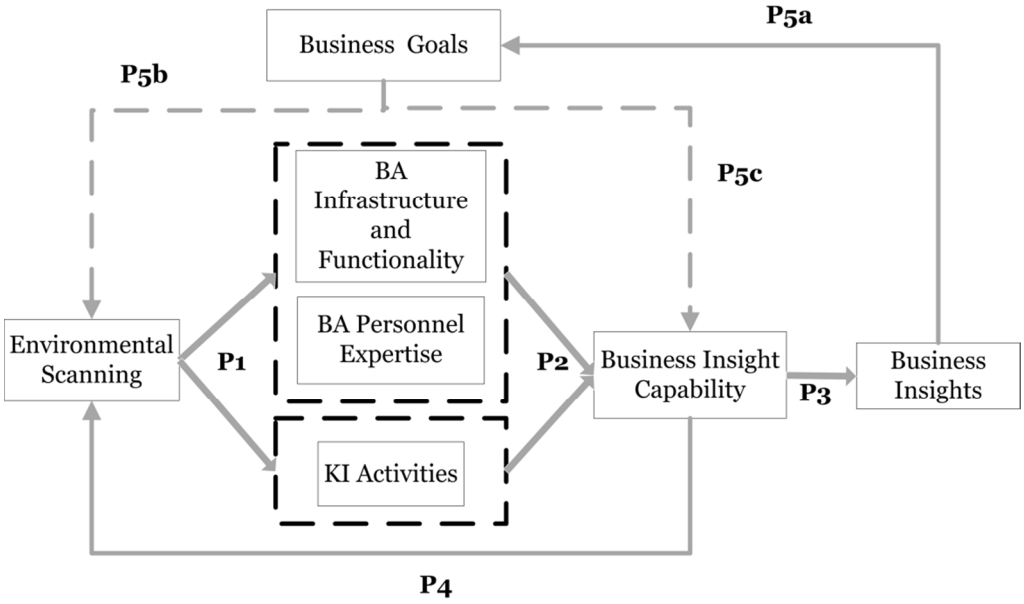

Figure 4. Findings and framework

Environmental Scanning as Sense Making

Sense making enables organizations to capture the changes in their external environments and identify threats and opportunities. Organizations take in new external information through environmental scanning activities. After the initial environmental scanning process, organizations can get a sense of where they are in the market and what they should do next. C2 commented on the importance of environmental scanning:

I think it's completely relevant and important because, at the end, if you don't use this type of information, you're basically working like blind.

When organizations do not realize the importance of environmental scanning in collecting external information, they do not devote time and money to this activity or develop ES plans in detail. This study suggests that environmental scanning is the initial step for further analysis and decision making, which provides sense making for events and actions:

P1: Environmental scanning performs as a sense-making process, the results of which provide inputs for BA tools and KI activities.

The Integration of BA and KI

Most of the tools organizations used for BA activities can only deal with structured or semi-structured data, while ES can provide decision makers with unstructured data as well. In this case, it is necessary to consider the role of KI.

Most of the respondents work at the managerial level. They usually perform ad hoc work on which the information requirements and working procedures are not clear. C8 is a senior business analyst. She uses BI tools daily to track customers' behaviour and make trend analyses. She said,

There are structured analysis that are quick because they were needed on a weekly or monthly basis, but the majority of them were ad hoc according to the needs of the business.

Her organization sets up a professional team that is responsible for the quality of data, which provides a guarantee for the quality of her analytics work.

But sometimes the data were not in the form she wanted, so she had to do evaluation and validation herself:

[The data have] gone through different processes to eliminate some duplicates … however the [BA] team had to do some other kind of processes to track the rest of the data and, once I had it in my hands, I had to review and redo the process because the data and the relationships around them were not so perfect.

From C8's case we can infer that BI and KM can be at least integrated in several ways, and Figure 5 shows BA and KI's interaction from our analysis.

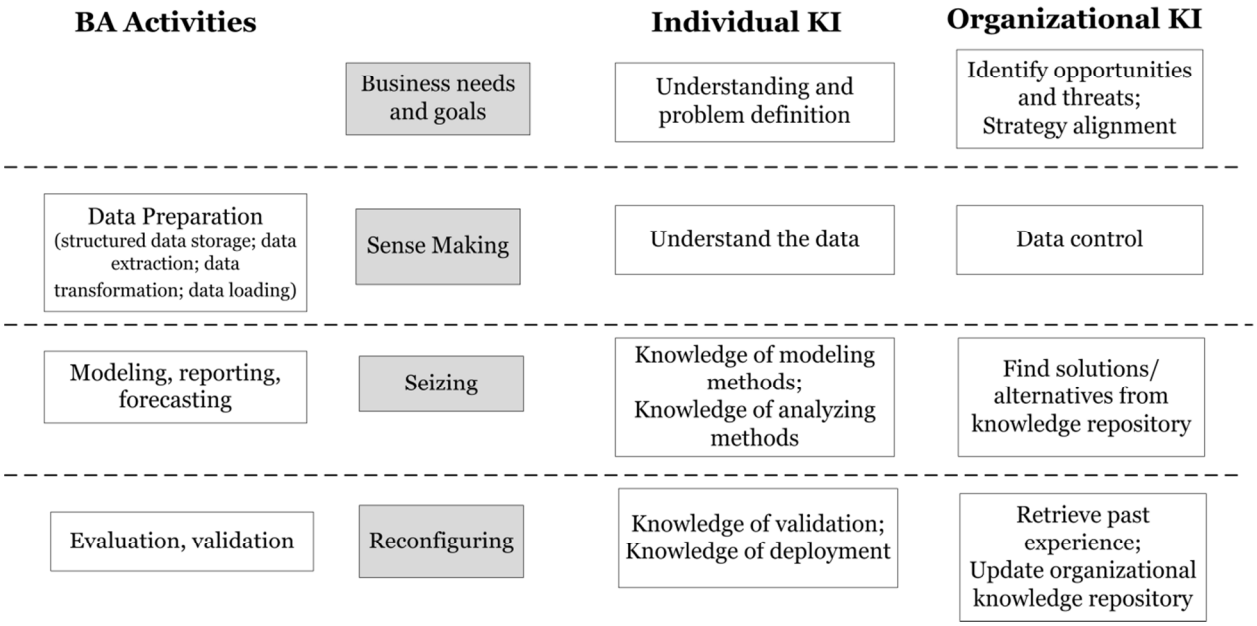

Figure 5. Interaction between BI and KM

Overall, BA and KI are complementary and the integration of BA and KI can be a big driver of business development:

I think that if we had a tool that was able to figure out how to actually analyze that data, that would have been a huge business driver for us. But, unfortunately, we weren't that sophisticated yet (C3).

Given this, we propose the following:

P2: KI and BA are complementary in that the integration of these two capabilities provides organizations with a higher potential to obtain business insight capabilities.

As mentioned before, managers need to equip themselves with the knowledge of data validation and deployment so that they can use the information properly to reach the right conclusion. This is part of the integration process which helps firms generate business insight capabilities, C7 earned a graduate education in statistics. For him, the skill of statistical analysis is a good weapon to validate the BA results and to help him get better business insights:

I think the tool and analytical steps—they have to [be] combined together. . . You can generate reports simply from the database, and then you need to have some statistical knowledge to really get insights.

This supports the third proposition:

***P3:** Business insight capability can help organizations generate business insights through data utilization, validation and integration processes.*

The Role of Business Insight Capability: Seizing and Reconfiguring

The charm of business insight capability is that it is dynamic. The influence of BA–KI interaction and business insight generation is not a simple chain reaction with a fixed sequence. Actually, the central role of business insight capability leads to a formation of a loop that influences environmental scanning activity. C6 confirmed this claim:

They do feed each other. . . . [A]s environmental scanning, to be perfectly honest, and [BA] tools are more sophisticated and more reliable, I think the overall impacts are to make changes. . .

Based on this evidence, we propose the following:

P4: *Business insight capability drives environmental scanning activities in a feedback process in order to improve the effectiveness of BA and KI integration to enhance the performance of business insight generation.*

Additionally, the results of our interviews have shown that business goals are triggers of the whole iterative process, and these results are consistent with Davis's (2008) pyramid framework in which business goals and strategies should be on the top, supported by all information flows. In the loop, the final products of ES-BA-KI activities, the business insight, modifies and develops new business needs and goals that will in turn modify and develop new ES objectives. C1 said,

I think most of the time we use the information we collected from external [environment] to influence the decision inside.

Her organization performs environmental scanning activities to generate business insight about the market, which in turn helps the organization modify its strategy and business needs. This is part of dynamic capability, which encourages organizations to adjust their resource base purposefully to react better to market change. Thus, we propose that:

P5a: Organizations' business goals are influenced by business insights, through which organizations modify, rearrange, or develop new goals and objectives.

P5b: Business goals may trigger environmental scanning activities by modifying and updating information needs, seeking, and usage.

P5c: Business goals help organizations set up new business insight capabilities by adjusting BA-tool usage patterns and KA requirements.

Discussion

Based on the results of this case study, BA and KI do not have a direct impact on ES activities. However, by integrating BA and KI, organizations can potentially gain business insight capability. Both ES and BA–KI activities should follow business needs and goals, meaning business insight capabilities not only influence ES activities directly, but also have indirect effects through business goal adjustment after gaining new business insights.

The findings of this paper make several contributions. First, the majority of BA tool research is technology oriented and therefore usually less meaningful for business practitioners. This study adds to the body of knowledge of BA from a managerial perspective, which may have more influence on organizations' technology management and KI.

Second, this study is an initial attempt to address the gap between KI and BA. Although many researchers have recognized the importance of integrating knowledge management and business analytics, there are very few empirical studies in this area. This paper also explains the different stages and forms of KI in compensating for the knowledge needed when using BI tools. By drawing dynamic capability as the theoretical background, this paper gives some clues about why BA or KI alone cannot provide business value from business insight generation to some organizations. As an implication for practice, the investment in BA or KI in isolation may not produce the expected return.

Third, this study contributes to the dynamic capability theory literature. Because dynamic capabilities perform important roles in bridging a firm's resource mix and its changing environment, business insight

capability is an important dynamic capability that can help firms adjust their activities and resources when faced with changing markets. This study provides more direct evidence of dynamic capabilities.

The main limitations of this exploratory research are the relatively small sample of cases used, and the possible variations in interpretation by the individual interviewees of the main concepts being studied. Further research will reduce these limitations.

Conclusion

In essence, this study noted that without dynamic capability it is impossible to integrate BA and KI capabilities and to adjust ES activities quickly when business needs and goals are changing after sensing and seizing business insight.

In future research, practical measurements should be developed so that organizations can self-assess the degree to which their BA and KI capabilities are integrated. Most of the current research looks at KI and information systems in isolation. But from this exploratory research, we observe that a mismatch or lack of integration between KI and BA capabilities may not be advantageous to an organization.

REFERENCES

Aguilar, F. J. 1967. *Scanning the business environment*, Journal of Business (Vol. 40) New York: Macmillan.

Alavi, M. and Marwick, P. 1997, *One Giant Brain*, Harvard Business School, Boston, MA.

Alavi, M., and Leidner, D. E. 2001. "Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues," *MIS Quarterly* (25:1), pp. 107–136.

Albright, K. S. 2004. "Environmental scanning: radar for success". *Information Management Journal*, (38:3), pp.38-45.

Amin, A., Cohendet, P. 2004. *Architectures of knowledge: Firms, capabilities, and communities*, Oxford: Oxford University Press.

Barki, H., and Pinsonneault, A. 2005. "a model of organizational integration, implementation effort, and performance," *Organization Science* (16:2), pp. 165–179.

Bose, R. 2009. "Advanced analytics: opportunities and challenges," *Industrial Management & Data Systems* (109:2), pp. 155–172 .

Bourgeois,Lionel John, I.,II. 1978. Strategy making, environment, and economic performance: a conceptual and empirical exploration. (Order No. 7814409, University of Washington). ProQuest Dissertations and Theses.

Chen, H., Chiang, R. H. L., and Storey, V. C. 2012. "Business Intelligence And Analytics: From Big Data To Big Impact," *MIS Quarterly* (36:4), pp. 1165–1188.

Choo, C. W. 2001. "Environmental scanning as information seeking and organizational learning," *Information Research* (7:1), pp. 1–37.

Choudhury, V., and Sampler, J. L. 1997. "Information Specificity and Environmental Scanning: An Economic Perspective," *MIS Quarterly* (21:1), p. 25.

Creswell, J. W. 2007. *Qualitative Inquiry and Research Design: Choosing Among Five Approaches,* Australasian Emergency Nursing Journal (Vol. 11).

Costa , Jorge . 1995. "An empirically-based review of the concept of environmental scanning," *International Journal of Contemporary Hospitality Management* (7:7), pp. 4–9.

Daft, R. L., and Weick, K. E. 1984. "Toward a Model of Organizations as Interpretation Systems", *Academy of Management Review* (9:2), pp. 284–295.

Davenport, T. H. 2006. "Competing on Analytics Competing on Analytics," *Harvard Business Review* (84:1), pp. 98–107.

Davenport, T. H., Barth, P., and Bean, R. 2012. "How ' Big Data ' is Different," *MIT Sloan Management Review* (54:1), pp. 22–24.

Davis, J. R. 2008. "Does environmental scanning by systems integration firms improve their business development performance?," ProQuest Dissertations and Theses.

Eisenhardt, K. M. 1989. "Building Theories from Case Study Research," *Academy of Management Review* (14:4), pp. 532–550.

Eisenhardt, K. M. K. M., and Martin, J. A. J. a. 2000. "Dynamic capabilities: what are they?," *Strategic Management Journal* (21:10-11), John Wiley and Sons, pp. 1105–1121.

Ferguson, G., Mathur, S., and Shah, B. 2005. "Evolving From Information to Insight Information to Insight," *Image* (46:2).

Fransman, M. 1994. "Information, knowledge vision and theories of the firm," *Industrial and Corporate Change* (3:3), pp. 713–757.

Ghezzi, A., Rangone, A., and Balocco, R. 2013. "Technology diffusion theory revisited: a regulation, environment, strategy, technology model for technology activation analysis of mobile ICT," *Technology Analysis & Strategic Management* (25:10), pp. 1223–1249.

Glaser, B. G., and Strauss, A. L. 1967. *The Discovery of Grounded Theory: Strategies for Qualitative Research Observations*, Transaction Publishers (Vol. 1).

Grant, R. M. 1996. "Prospering in dynamically-competitive environments:organizational capability as knowledge integration," *Organization Science* (7:4), pp. 375–387.

Heinrichs, J. H. 2001. "Interaction effects of strategic decision models and business intelligence tools on knowledge generation in manufacturing firms," ProQuest Dissertations and Theses.

Helfat, C. E., Finkelstein, S., Mitchell, W., Peteraf, M. A., Singh, H., Teece, D. J., and Winter, S. G. 2007. *Dynamic capabilities: Understanding strategic change in organizations*, John Wiley & Sons.

Helfat, C. E., and Peteraf, M. a. 2003. "The dynamic resource-based view: capability lifecycles," *Strategic Management Journal* (24:10), pp. 997–1010.

Herschel, R. T., and Jones, N. E. 2005. "Knowledge management and business intelligence: the importance of integration," *Journal of Knowledge Management* (9:4), pp. 45–55.

Hislop, D. 2002. "Mission impossible? Communicating and sharing knowledge via information technology," *Journal of Information Technology* (17:3), pp. 165–177.

Kim, G., Shin, B., Kim, K. K., and Lee, H. G. 2011. "IT Capabilities, Process-Oriented Dynamic Capabilities, and Firm Financial Performance," *Journal of the Association for Information Systems* (12:7), pp. 487–517.

Kogut, B., and Zander, U. 1992. "Knowledge of the Firm , Combinative Capabilities , and the Replication of Technology," *Organization Science* (3:3), pp. 383–397.

Kohavi, R., Rothleder, N. J., and Simoudis, E. 2002. "Emerging trends in business analytics," *Communications of the ACM* (45:8), 45-48.

Kourteli, L. 2000. "Scanning the business environment: some conceptual issues," *Benchmarking: An International Journal* (7:5), pp. 406–413.

Lavalle, S., Lesser, E., Shockley, R., Hopkins, M. S., and Kruschwitz, N. 2011. "Big Data, Analytics and the Path From Insights to Value," *MIT Sloan Management Review* (52:2), pp. 21–32.

Maier, J. L., Rainer Jr., R. K., and Snyder, C. A. 1997. "Environmental Scanning for Information Technology: An Empirical Investigation.," *Journal of Management Information Systems* (14:2), pp. 177–200).

Saxena, R., & Srinivasan, A. 2012. *Business Analytics: A Practitioner's Guide (Vol. 186)*. Springer.

Stubbart, C. 1982. "Are environmental scanning units effective?," *Long range planning* (15:3), pp. 139–145.

Teece, D. J. 2007. "Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance," *Strategic Management Journal* (28:13), pp. 1319–1350.

Teece, D. J., Pisano, G., and Shuen, A. 1997. "Dynamic capabilities and strategic management," *Strategic Management Journal* (18:7), pp. 509–533.

Trkman, P., McCormack, K., De Oliveira, M. P. V., and Ladeira, M. B. 2010. "The impact of business analytics on supply chain performance," *Decision Support Systems* (49:3), pp. 318–327.

Vinekar, Vishnu, James T C Teng, & Anitha Chennamaneni. 2009. "The interaction of business intelligence and knowledge management in organizational decision-making". *Journal of International Technology and Information Management* (18:2), pp.143.

Vriens, M., and Verhulst, R. 2008. "UNLEASHING HIDDEN INSIGHTS. (cover story)," *Marketing Research* (20:4), pp. 12–17.

Yasai-Ardekani, M., and Nystrom, P. C. 1996. "Designs for Environmental Scanning Systems: Tests of a Contingency Theory," *Management Science* (42:2), pp. 187–204.

Yin, R. K. 1994. *Case study research: Design and methods*. Thousand Oaks, CA: Sage.

Yin, R. K. 2003. *Case Study Research: Design and Methods Essential guide to qualitative methods in organizational research* (Vol. 5) Sage Publications .

Zollo, M., and Winter, S. G. 2002. "Deliberate Learning and the Evolution of Dynamic Capabilities," *Organization Science* (13:3), pp. 339–351.

Appendix A. Description of 15 Cases

		Case 1-C1	Case 2-C2
Industry		Telecommunication firm	Multinational beverage company
Position		Financial analyst	Strategy team member
BI tool	Infrastructure	Oracle	In-house building BI tool
	Function (major)	Dashboard generation, report generation, model building	Consolidating trade data, chart generation, report Generation, benchmarking, performance monitoring
	Data	Updated monthly	Updated at least three times per week
	Usage frequency	Monthly; standard process	Daily; reactionary usage based on needs
	Usage objective	Performance monitoring, forecasting	Monitoring trade performance, forecasting sales
ES	Information needs	Focus on well-defined issues, such as customers information regarding buying patterns, needs, website browsing habits, etc. and competitors' marketing information	Field information (sales, customers, traders, dealers, market, industry) based on well-defined search goals
	Information source	Standard and highly respected sources such as public online databases	Trade representatives gather information from the street or from the field
	Information usage	Marketing research team pulls in the database after formal research activities, uses information to interpret user behaviour and explore market potential.	Field trade representatives upload data to database, and on-site employees double check the information before end users (e.g., managers, other sales representatives, analysts) download data for use in discovering and forecasting industry potential.
	Frequency	Monthly	Daily
	Pattern	Standard and structured	Structured or ad hoc
KM capability		**Medium:** Have standard KM practices and regulations to some extent; Have standard build-in models to guide analytical activities; Provide training when necessary; Smooth internal communication; Have a centralized repository; Have regular meetings and brainstorming	**Medium:** Smooth flow of information; Regular company-wide and team-wide training; Have a centralized repository; Easy to communicate and share knowledge within the department, but may be hard to communicate across departments; Organizational reorganization of knowledge assets and their value.

	workshops to generate new ideas and exchange information/knowledge.	

		Case 3-C3	Case 4-C4
Industry		Energy consulting firm	Oil and gas company
Position		Project manager	Project manager
BI tool	Infrastructure	Excel and in-house building tools	Oracle
	Function (major)	Scenario analysis, simulation, performance indicators, matrix building	Filters and query, report generation, graph generation, metrics, model building
	Data	Reactionary updated data	Monthly consolidated data
	Usage frequency	Ad hoc	Three to four times per week for both structured and ad hoc processes
	Usage objective	Aware of the market situation and sudden events	Performance monitoring, sales management, quality control, sales prediction
ES	Information needs	Government and policy information; changes in laws and regulatory issues; politics (well-defined search goals based on projects)	Industry information based on well-defined objectives
	Information source	Standard and well-respected sources, such as official websites, public databases, news agencies, etc.; personal contacts	External consulting firm
	Information usage	Collect information when the demands are identified; rely more on irregular contacts; more reactionary to events; usually pull data into database for future analysis	Try to discover the industry; compare industry data to company's performance to control day-to-day business and predict the future
	Frequency	Ad hoc	Regular
	Pattern	Reactionary and ad hoc	Structured
KM capability		**Low:** Knowledge assets are identified, but there are no systematic mechanisms to manage them; No intelligent tools or centralized knowledge repository; Largely depends on personal contacts to identify new	**High:** Advanced KM system and support team; Value of knowledge is recognized by the entire organization; KM activities are embedded and required in the daily work flow;

	knowledge and perform limited transfer and sharing process; KM processes are not required as part of the workflow.	Employees have a platform and find it easy to share and acquire knowledge.

		Case 5-C5	Case 6-C6
Industry		Retail	Marketing firm
Position		Strategy and operations	Business analyst
BI tool	Infrastructure	In-house building BI tools	Google Analytics
	Function (major)	KPI monitoring, customer engagement monitoring, metrics, sales monitoring, report generation	Usage monitoring, prediction
	Data	Real-time updates (24-hour delay)	Gather data based on demands
	Usage frequency	Bi-weekly usage	Daily
	Usage objective	Performance monitoring	Monitor user behaviour, prediction
ES	Information needs	Customer and industry information required for testing new products or markets	Key stakeholders' information focused on predefined objectives
	Information source	Public and well-respected sources such as industry reports and news; external consulting firm or surveys	Research and analytical team track key stakeholders' information daily through a closed-end system
	Information usage	Focus on discovering and updating existing knowledge, such as market potential and customer insights; Try new products and markets to see what happens	Develop interpretations of external environment
	Frequency	Project-specific	Daily and continuous
	Pattern	Proactive, both structured and ad hoc	Structured, clear goals and procedures
KM capability		**Medium:** Regular training programs to help employees acquire new knowledge; Value of knowledge assets is recognized throughout the entire organization;	**Low:** Major knowledge-generation activities are based on individuals and employees' personal contacts; Hierarchical communication structure; Sharing of knowledge is not practiced;

	Sharing of knowledge is embedded in the workflow.	Knowledge assets are not systematically managed.

		Case 7-C7	Case 8-C8
Industry		Banking	Financial service company
Position		Customer analyst	Business analyst
BI tool	Infrastructure	SAS	In-house building BI tools
	Function (major)	Report generation, model building, chart generation, statistical analysis	Data extraction, report generation, KPI tracking, performance monitoring, visualization functions
	Data	N/A (not mentioned)	Updated every week or every 2 weeks
	Usage frequency	Daily and monthly (different objectives)	Daily
	Usage objective	Track customer behaviour, trend Analysis, prediction	Performance analysis, descriptive analysis
ES	Information needs	Customers' information focused on target business objectives	Based on analysis objective, such as suppliers and partners' information
	Information source	Surveys, data bought from credit bureaus or the other certified companies	Existing database
	Information usage	To discover and interpret the key customer needs and company's current situation; to update existing knowledge	To confirm the situation and routinize interpretation of the environment; to discover new trends and opportunities
	Frequency	Regular	Weekly and monthly
	Pattern	Structured by formal and routine procedure	Some structured work, mostly ad hoc
KM capability		**Medium:** Knowledge assets are identified, and the value of knowledge is recognized by the organization; Sharing of knowledge assets is practiced but limited to each position; Employees in certain positions (usually higher-level positions) find it easy to acquire and share knowledge.	**Medium:** The value of knowledge assets is identified; Have a centralized repository; Employees may have personal knowledge databases; Sharing of knowledge is not practiced, and its importance may not be recognized throughout the entire organization.

		Case 9- C9	Case 10- C10
Industry		Medical association	Manufacturing (energy)
Position		Statistical data analyst	Financial analyst
BI tool	Infrastructure	SAS	IBM Cognos (now Oracle)
	Function (major)	Report generation, automated e-mail generation	Report generation, trend analysis, forecasting
	Data	N/A	Refreshed every day
	Usage frequency	Daily	Daily
	Usage objective	Performance monitoring	Sales monitoring and inventory control
ES	Information needs	Clients' information	Well-defined search goals for customers, industry, and market
	Information source	Clients bring data and information to the organization	Direct customer interaction; trade shows; conferences; consulting firms;
	Information usage	To confirm the current situation	To discover new trends; solve clients' needs; revise and update existing knowledge about the market, economy, technology, industry, etc.
	Frequency	Daily and annually	Regular
	Pattern	Passively receives data from clients and sometimes get data updated from other associations	Passively listens to clients' needs; proactively searches for industry and market information from various channels; has formal and routinized channels
KM capability		**Low:** Have documentary system; The organization is not intent on transferring new knowledge into public assets; Knowledge sharing is not practiced, and employees lack tools and willingness to share knowledge.	**High:** Centralized repository; Formal procedures to retrieve knowledge; Employees can be successful in locating and retrieving relevant knowledge; The value of knowledge assets is recognized by the organization, and KM activities are performed by the upper-level management.

	Case 11- C11	Case 12- C12
Industry	Electricity transmission company	Manufacturing (food)

Position		Business analyst	Marketing manager
BI tool	Infrastructure	Oracle	IBM Cognos
	Function (major)	Ad hoc reports, routine reports, trend analysis	KPI reports
	Data	Real-time (cloud-based)	Refreshed weekly
	Usage frequency	Daily	Daily and continuous
	Usage objective	Performance monitoring; find gaps in day-to-day business	Performance monitoring
ES	Information needs	Customers' information; project-specific information based on well-defined goals and regulatory requirements	Market share reports; competitors' information; advertisement information for the whole market; price points
	Information source	Survey or market research that is structured, objective, and formal	Standard data from well-respected sources such as public databases and external consulting firm
	Information usage	To interpret organization's current performance compared to market environment	To analyze the market; to analyze the firm's market performance; cooperate with sales team to forecast profit margin (discover new markets or trends)
	Frequency	Regular	Monthly
	Pattern	Proactive approach to customers by formal and objective means such as surveys or customer incentive program	All information is provided by the system (service); employees regularly filter data according to business needs
KM capability		**High:** The culture of the organization encourages KM activities; Regular training helps employees acquire new knowledge; Transparent on roles and responsibilities so that employees can easily locate needed knowledge assets; Have monthly scorecards and presentations to share knowledge; Sharing of knowledge is practiced; Employees find it easy to share knowledge and have a willingness to manage knowledge assets.	**Medium:** Centralized repository; Sharing of knowledge is not practiced, but KM activities are quite usual within teams and departments; Employees can easily locate knowledge if necessary.

		Case 13 (Survey)-C13	Case 14 (Survey)-C14
Industry		Financial service	N/A
Position		N/A	Manager
BI tool	Infrastructure	SAS, Excel	SAP
	Function (major)	Report generation, building dashboards, creating figures and charts, trend analysis, forecasts	Report generation, trend analysis, monitor organization's activities
	Data	Historical data	Real-time
	Usage frequency	Daily	Weekly
	Usage objective	Performance monitoring, market forecast	Performance monitoring
ES	Information needs	Customer, industry, competitor	Customer, government, industry
	Information source	Journals and trade press; conferences	Personal contacts
	Information usage	To discover, revise, and update existing knowledge	To discover future market trends, try new behaviours, and see what happens
	Frequency	Weekly	Reacting to special events
	Pattern	Reactively receive information; actively search information with rigorous and formal procedure	Reactively collect information, usually through personal contacts external to the organization
KM capability		**Medium:** Centralized repository; Regular training to help employees acquire new knowledge; Regular meetings and presentations to integrate and share knowledge.	**Medium:** Centralized repository; Regular employee news releases to help employees stay informed about new knowledge and facilitate knowledge sharing; Regular brainstorming sessions to generate new ideas.

		Case 15 -C15
Industry		Utility
Position		Market analyst
BI tool	Infrastructure	Oracle, SAP, Excel

	Function (major)	Report generation, data extraction, trend analysis
	Data	Updated data
	Usage frequency	Monthly, daily
	Usage objective	Estimation and prediction
ES	Information needs	Market
	Information source	IT department feeds external data into database
	Information usage	To confirm market situation
	Frequency	Regular
	Pattern	Driven by legislation and mandates; both structured and ad hoc work; fair, efficient, openly competitive principle
KM capability		**Medium:** Professionals analyze data and get business insights; have channels to distribute business insights; Regular training to help employees acquire new knowledge; Regular meetings and presentations to integrate and share knowledge; Centralized repositories; New employees may have difficulty locating knowledge.