Leveraging Business Intelligence to Build Meta-knowledge

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Abstract

Over the years, many organizations have implemented business intelligence (BI) systems as an initiative towards dynamically creating and managing information that enables real-time responses to business and process variations using focused analytical assessments. This study captures the essence of BI practices that are most responsible for optimizing organizational performance by applying analytic processes and transforming enterprise-wide system data into knowledge for decision making. Findings reveal that although organizations have been able to improve processes and rationalize the business value chain using BI, these firms often lack clarity in evaluating needs and identifying the context of information critical to their success. Companies are now extending capabilities via knowledge-based processes to simulate business scenarios and align key performance metrics with critical functions, to build meta-knowledge from data extracts using BI tools.

1. Introduction

In the information processing view of knowledge, two key organizational initiatives that assist in leveraging enterprise-wide data and improving the quantitative and qualitative value of knowledge available are business intelligence (BI) and knowledge management (KM). BI systems, referred to as “data-driven DSS” [1] supports business strategy. The BI process includes data access and reporting, as well as analytics to analyze business performance [2]. Whereas, KM provides the capability to encapsulate and access work-oriented information and decisions from managers and staff [3]. Intelligence in enterprises is created through the congruence of BI and KM solutions that “provide the in-depth analytical capabilities needed to turn raw data into actionable knowledge for an enterprise” [4, p. 2]. Organizations have deployed enterprise systems (ESs), also called enterprise resource planning (ERP) systems, to manage data sources for meeting their BI and knowledge requirements. Knowledge evolves iteratively, as low level discrete data is transformed into higher levels of information, to guide organizations into making knowledgeable decisions at functional levels. Decisions are converted into actions, which lead to new results for subsequent decision making and future planning. As knowledge evolves into meta-knowledge (knowledge about pre-selected knowledge [5]), organizations sieve through relevant data in diverse functional areas to build information intelligence (capability to use information assets successfully [6]). BI tools assist in extracting relevant data from different data repositories for analytical decision making in order to utilize available ES information. Even though the importance of BI has been realized, there has been a lack of research and theoretical advances on the management and outcomes of these technologies [7]. In one study relating to the effects of institutionalization of information technology (IT) in organizations, Baptista et al. [8] found that as new technology is embedded in business processes, it loses management sight leading to under-exploitation of its strategic value. Organizations want to evolve by reviewing existing strategies to optimize and realize business value from their IT investment. However, these firms generally lack clarity on the information critical to their success. This study looks into this gap in the context of BI technology to investigate which BI practices are most critical to the successful transformation of raw data into meta-knowledge?

The study has been conducted in two phases. In the first phase, a study was undertaken with vendors and consultants of major ES players who have implemented BI systems to gain a broad perspective of the capabilities offered by these tools, and the extent of their utilization within the New Zealand (NZ) market. In the second phase, managements of two large hi-tech electronics-manufacturing firms using BI tools were interviewed to understand their practices and scope of BI utilization. Thus, insights from both, BI vendors/consultants and users, is a distinctive and major contribution of this study.

This paper is organized as follows. This section has introduced the intent of the study. The next section lays the theoretical foundation with reviews of prior related literature. An analysis of how BI process fits in the ES data transformation framework is explained in the third section, which provides the methodological guide for this study. The fourth section outlines the research
methodology and gives an overview of the two stages in conduct of the study. The fifth and sixth sections discuss findings from key ES vendors/consultants and two NZ firms who have implemented BI systems. The concluding section summarizes the results of the study.

2. Enterprise Systems, Business Intelligence, and Knowledge Management

For driving business functions effectively, organizations have realized that data captured by different functional groups must be made available on a shared platform for knowledgeable decision making. Thus data has moved from esoteric forums having few knowledgeable users to enterprise-wide data environments facilitating knowledge sharing among more users belonging to different functional teams. An ES enables this point of collaboration and constitutes an important aspect for organizational knowledge creation since it is the fundamental tool in the intelligent enterprise [9]. ESs generally consist of a series of modules comprising different sets of functional capabilities shared from a central repository to provide a comprehensive view of the enterprise’s operations [10]. The modular integration of information flows within a common data repository enforces standardization with the use of templates that reflect “blueprints for best practices” processes [11, p. 153]. In some cases the ES is adapted through customization to meet specific functional requirements of the organization that were not originally offered by that system. Hence, an enterprise system is “a generic solution with different levels of adaptability, which makes every implementation unique in some sense since an organization must configure the system to its own specific requirements” [12, p. 82].

BI and KM systems enable transformation of data into meaningful information, insightful analysis leading to action, and the evaluation of results further leads to creation of organizational meta-knowledge. "BI is a set of methodologies, processes, architectures, and technologies that transform raw data into meaningful and useful information used to enable more effective strategic, tactical, and operational insights and decision-making [13]." KM is “the ability to selectively capture, archive, and access the best practices of work-related knowledge and decision making from employees and managers for both individual and group behaviors” [14, p. 6]. BI has applied functionality of data warehouses to support collection, analysis, and reporting on organizational data in all of the business activities throughout the value chain [15]. The BI tools and platforms are available from large enterprise system vendors such as SAP, Oracle, and Microsoft and mid-sized specialist BI companies such as Cognos, Crystal/Business Objects, and Hyperion/Brio. These vendors have developed BI applications utilizing on-line analytical processing function that provide features such as ad-hoc queries, enterprise and end user analytical reporting, as well as some typical scorecard or dashboard functionalities [16]. Recent research has found that BI plays an important role in implementing and monitoring strategies such as sustainable practices [e.g., 17]. The ability to provide information in real-time, assists firms in current decision making [18]. Some of the key functionalities of BI tools to enable sharing of enterprise-wide information across different functional units for decision making are summarized in Table 1.

The rationale for KM is based on the understanding that the most valuable assets of an organization are the skills and knowledge employees possess and the means of capturing and sharing that knowledge is vital. KM helps in creating a collaborative work environment, discourages departmental silos to enable knowledge distribution and saves on duplicating effort, reducing cost and time spent [19]. KM solutions facilitate knowledge creation by codifying experiences and contexts into operational procedures, and integrating into existing IT infrastructure and work practices [16]. Over the last decade, KM technologies have evolved into the current technology-push model moving towards the emerging strategy-pull model. The technology-push model uses the premise that knowledge can be pushed to the right people at the right time with the use of technology. Whereas, strategy-pull model represents organizational methods that combine data management systems (e.g., ESs) with the creative and innovative capacity of human beings to develop and enhance knowledge intensive business processes [20]. BI supports and enables such strategic pull-based knowledge management processes, with the ability to extract raw data and transform into actionable knowledge.

As firms synergize business operations across business units, their dependence on enterprise-wide data resources (IT infrastructure, common business processes, and shared data) is increasing [21]. ES suppliers have extended their applications to include modules such as customer relationship management (CRM), supply chain management (SCM), BI, and KM (e.g., data warehousing) to realize collaboration needs of organizations. Enterprise alignment helps strengthen internal capabilities and assists in managing interdependencies between software applications, IT services, and business objectives [21]. Future ES applications are expected to support the competitive business environment through more Internet-enabled collaboration embedded with better intelligence [22].
Table 1. Key functionalities of BI tools that assist in decision making

<table>
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<tr>
<th>Purpose</th>
<th>BI functionalities</th>
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| Business reporting                         | • Provide ability to drill down through layers of data, and do the analysis in any (spreadsheet, charts, hyperlinks) without burdening user with technical details.  
• Assist in setting up of data filters, crosstabs, and user-friendly queries to answer specific questions.  
• Extend standard ES reports (e.g., aging analysis or order intake reports) to optimize capacity planning and improve productivity. The underpinning information and functional areas are not mutually exclusive. |
| Reduce information overload                | • Aggregate/distil meaningful information, to help managers know more about their business and start looking for correlations with specific questions, since ES implementations can be overwhelming causing information overload.  
• Data from heterogeneous environments can be mined and presented to users on a regular basis. |
| Support management performance evaluation  | • Balanced scorecards are used in conjunction with data mining to aggregate databases for performance evaluation expanding managerial analytical capabilities.  
• Help business managers create relevant data views to make knowledgeable decisions bringing clarity on critical information elements. |
| Business process simulation and scenario planning | • The built-in integrated reporting and dynamic query generation function allows users to extract intermediate data and assess different possible simulated outcomes.  
• Analytical processing can be applied to scenarios by adding experience, context, and interpretation.  
• Provide a point-in-time multi-view of the current progress of new initiatives, which can then be exploited to improve performance. |
| Add-on Features                            | • Enable organizations to identify a baseline against which standards could be defined and the information presented as a report, scorecard, or KPI, since many firms do not even know what they want to measure.  
• Customization with add-on features (e.g., a dashboard could provide more contextual information that helps in insightful decision making). |

3. ES Data Transformation Process

Davenport [23] identifies three vital phases in the process of organizational knowledge creation and results using an ES. The first phase establishes the context that includes pre-existing factors – strategic, organizational and cultural, skills and knowledge, data, and technology – that relate to the organizational aspects, policies, and procedures. The second phase is the data transformation, which occurs when the data are extracted, analyzed and used for business decisions. The third phase translates actions within the organization to reflect on outcomes relating to changes in behavior, operational processes, new initiatives, and financial growth. However, the major challenge in the data transformation process is the extraction of real intelligence from the massive data feeds and link business decisions into the overall value creation process [24]. Most often, BI is conceptualized as an IT artifact however, to evaluate the comprehensiveness of the BI process, not only the BI artifact needs examination, but also contexts such as people and their capabilities and other organizational practices [25].

This study investigates how the BI process is incorporated within the data transformation framework in ESs to create meta-knowledge for achieving organizational benefits. The BI process, enabling the transformation of data into knowledge, is usually deployed in the second phase of ES implementation when the organization is mature with the ES, which leads to the additional benefits [26]. Interactive BI tools build credibility to the analytical and decision-making process by linking multiple contexts to provide a realistic reflection of how one lagging or leading process parameter can impact different functional areas and lead to changed outcomes in the data-to-knowledge-to-results process. An examination of this phase would explain the impact of BI processes on generating organizational meta-knowledge. The holistic model that incorporates the ES data transformation process, utilizing BI to link specific contexts for creating meta-knowledge and outcomes across functional and organizational boundaries, is shown in Figure 1.

When the BI tools are incorporated in building meta-knowledge, analytical thinking is instigated into ES data for better decision making. Users query data in a logical and intuitive manner without getting burdened by unnecessary information overload. From Figure 1, it is evident that the organizational strategy drives the analytical process. The relevant data are extracted and analyzed through the BI process for decision making to achieve goals. The new initiatives and process changes are driven by the business objectives supported by analytical decision making. The BI system utilizes the firm’s knowledge assets primarily, the ES data and enables the knowledge-based processes to guide decisions and implement actions.
The analytical processes lead to development and utilization of meta-knowledge for new initiatives and improvement programs. Thus, the transformation process specifies how BI processes support organizational goals realization. Data assets are analyzed for links and interdependencies in different contexts using BI tools and technologies. It is however, realized that the BI technology could be constrained to provide precise information at times, which could impact the effectiveness of the knowledge-based processes.

This study empirically examines these aspects in the transformation phase to evaluate the hierarchy of goals, knowledge enabling BI processes, utilization of data assets to build meta-knowledge and its impact on realizing beneficial outcomes, with a review of limitations, if any.

4. Research Methodology

The research design comprises two stages. First, the study gains insights into current BI implementation practices from the unique perspective of ES vendors/consultants, and IT research firms (e.g., SAP, Oracle, Microsoft, PricewaterhouseCoopers, IDC). This is followed by an in-depth investigation of two large cases who have implemented BI systems. Sixteen face-to-face semi-structured interviews were carried out with key respondents using the ES. The participants included senior executives, managers, and operational staff in the organizations actively engaged in managing the BI and utilization of ES data for decision making. The selection of cases was based on snowball sampling strategies [27] through the study with ES vendors/consultants using three predetermined criteria: (1) both organizations are in the manufacturing sector and this is significant because the characteristics of manufacturing organizations especially motivates ES adoption [28], (2) the organizations belong to the same industry class – the high-tech electronics manufacturing – allowing common conditions for comparison, and (3) both cases are in the second phase of ES implementation, that is, should have implemented ES and BI for at least three years and so are mature with their implementations. The multiple case research utilizes a theoretical framework from the literature and establishes the study’s context. Theoretical propositions have been analyzed to compare the empirical findings with extant literature to answer the research questions [29]. The a priori specification of constructs comprises the contextual, transformation, and outcomes phase in the transformational model (Figure 1), which relate to creation and utilization of information intelligence for building meta-knowledge.

In the interview, questions were asked to extract information on the most critical BI practices for the successful transformation of raw data into meta-knowledge for analytical decision making. The focus was also brought into examining the hierarchy of organizational goals, knowledge enabling BI processes, utilization of data assets, and its impact on achieving outcomes as identified in the transformation process (Davenport’s model).

Figure 1. ES data transformation model utilizing BI, adapted from Davenport [23]
5. ES expert’s responses on BI practices

The findings from ES vendors/consultants confirm that the market for BI tools is growing as more and more businesses realize the analytical and reporting capabilities of these tools to extract underlying information from massive data repositories. BI tools can integrate user-friendly dynamic on-line queries with ES data to provide specific business information, which can be further evaluated via business reports, balanced scorecards, or dynamic dashboards to assess a firm’s status. For example, to track raw material availability of a particular item, “organizations run dynamic on-line queries to find WIP [work in progress] stock, warehouse stock, and stock currently in transport” explained the SAP respondent.

The BI systems are used to integrate disparate forms of data from multi-dimensional cubes of data warehouses that correlate data links to bridge the “analysis gap” between data and information to create meta-knowledge [26]. But the hardest aspect is being able to define what information is intelligent and useful. At the enterprise level, BI systems assist managements to build comprehensive views with aggregate data, and based upon their logical reasoning and absorptive capacity, improve processes and overall business productivity. Organizations develop new performance evaluation techniques to realize strategies by identifying the drivers for success. BI tools support users in examining different problem scenarios through “what if” analysis to explore and prioritize possible outcomes. For managing business strategies, the technique most commonly referred to by the ES vendors was the use of balanced scorecards with data extracted through BI. Concerns were although voiced on the effectiveness of their use, since balanced scorecards also required application of high-level strategic thinking. One ES vendor noted that usually firms when referring to a balanced scorecard “just mean KPI reporting”.

The ability to drill into layers of data aggregations, to extract relevant reporting metrics, is an essential component of building intelligence for decision making. However, in the context of NZ companies, Microsoft reported that there have been very few successful business intelligence implementations. The implementations work in that although reporting metrics are provided, but examples of companies using them strategically to implement analytic business decisions are not evident. Oracle explained that many NZ companies are using BI mainly as a basic reporting instrument as opposed to an analytical tool for achieving strategic benefits. Oracle emphasized BI tools must be tied to the middleware of the ES to drill into the underlying information as opposed to using it as a separate tool that only utilizes ad-hoc data fed into the system. SAP added that many NZ organizations have still not reached the maturity level to simulate business scenarios and align performance metrics to business processes. IDC and PWC stated that organizations are gradually realizing performance improvements with accurate and timely reporting of data, and are growing in maturity of BI usability; however, the progress is noted as slow [26].

6. Case study responses on BI practices

The main study involved two large high-tech electronics manufacturing organizations namely Bevon and Cevon (pseudonyms) who have implemented an ES including BI. Brief case descriptions of the two organizations are shown in Table 2. Semi-structured interviews were conducted to understand how these firms use BI tools for analytical decision making and build meta-knowledge.

6.1 Bevon practices

Bevon implemented SAP business data warehouse (BW) version 3.5 in 2005. This has been upgraded to business intelligence version 7.0 (BI7) in 2007. The IT specialists at Bevon had recommended the BW environment to help Bevon store sales forecast information accurately.

Table 2. Cross-case comparison of the two case studies

<table>
<thead>
<tr>
<th></th>
<th>Bevon</th>
<th>Cevon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Established</td>
<td>1967</td>
<td>1987</td>
</tr>
<tr>
<td>Original design manufacturer</td>
<td>Chipsets for telecommunication</td>
<td>Devices for marine, in-car navigation, and fleet tracking</td>
</tr>
<tr>
<td>Employees</td>
<td>750 (Large)</td>
<td>750 (Large)</td>
</tr>
<tr>
<td>ES</td>
<td>mySAP, 2004</td>
<td>SyteLine 7, 2006</td>
</tr>
<tr>
<td>Modules</td>
<td>Manufacturing, Finance, HR, BI (SAP version 7)</td>
<td>Manufacturing, Finance, BI (Cognos version 7), and Field service</td>
</tr>
<tr>
<td>Organizational growth</td>
<td>$44M (03)- $108M (07) 25% pa</td>
<td>$100M (03)- $500M (07) 50% pa</td>
</tr>
</tbody>
</table>
The information extracted from BW could then be aligned with their defined operational strategies. The IT project manager however, informed that the information extracted from BW is not directly transferred into the BI7 tool for generating reports. The SAP data output is subjected to manipulation through structured query language (SQL) statements based upon knowledge creation requirements. The resulting information from the query is viewed on Excel spreadsheets. The IS project manager explained “with this method it is possible to generate information by making SQL queries to exactly match the required business operational data. The users can then produce graphs, create pivot tables with data summaries, and have many other user-friendly data manipulation facilities in Excel that are more flexible and useful than a standard ABAP report from the SAP system”.

The KPI metrics are captured from ESs and benchmarked against targets based on industry standards or as approved by the management. Once the goals are defined, the executive team monitors and controls these goals through regular reviews. However, Bevon is yet not mature with its BI tool implementation to enable detailed reviews of their performance management system. Bevon management explained that they are awaiting their BI upgrade to Business Objects first.

The IT team at Bevon believes that the transactional data cannot be brought directly into BI system because of the way SAP BI is designed. The IS project manager explained: “that would swamp the BI tool with data. The transactional data are transferred by running some summary type programs, so that only summaries of the data are built, that can be used for reporting. The SQL database is used to do the number crunching to get the transactional data into a summarized cube which can then be sliced and diced any way required for reporting on any of the fields very quickly because the summary is already created”.

Therefore, rather than utilizing the BI functionality fully themselves through its built-in functions, the business managers at Bevon depend on their IT specialists to transform data and generate information. The IT manager further noted that if there is a need to view “the production order or sales order the information came from, that is not possible because summary data are used and there are no drill down capabilities...Although the current version of SAP BI is not effective, when the company upgrades to Business Objects, which is more powerful, the system will be able to handle transactional data. That will be beneficial for knowledge-building and will be used in addition to just the standard ABAP custom reports”.

6.2 Cevon Practices

Cevon has implemented a bolt-on BI application called Cognos Impromptu to their ES, SyteLine version 7 (SL7). The IT manager at Cevon opined that the BI tool is quite useful to users who need to create ad-hoc reports based on the challenges they face at any time. “It is a great tool for generating ad-hoc reports, where there is no need for the user to go to a developer and request a new report layout because a particular column that the user wants in the report is not there”. The manager further stated “when users have the ability to access the data easily they can quickly build a picture of the correct information and make better decisions. The tool helps to get required data out of the system quickly and efficiently”.

The IT manager clarified that the BI tool insulates the user from the complexities of the database, letting the user focus on analyzing the data that drives the business. It presents a business view of the information and controls the data access by users via the user permissions set. Many ad-hoc queries can be made using the BI tool through its local SQL-based query engine. The query is executed and the output is seen through user reports that can be refreshed periodically to retrieve real-time information. Users further enhance performance of queries and reports as they learn from experience. The performance of the BI tool can be optimized by applying filters and crosstabs, sorting the information, and creating summaries. Although, appreciative of the current BI reporting methods, the operations manager believed that SyteLine functionalities could have been enhanced with some more standard reports built into the system. “Everyone wants to see the data in a different way. It may never be possible to have enough reports built into the system that pleases everyone. As the people get more and more information, they look at it and then feel that it would be nice if they could look at it in a different manner and be able to slice and dice the information. With more and more information the knowledge is built up and people tend to want to view it differently because the people are learning something out of it. So, the requirements keep changing with time”.

However, the operations manager further noted that although the information was accessible through the BI module, people had to depend on the few users with BI licenses, which was always a problem since those people always appeared to be quite busy. “Getting a custom BI report would always involve a bit of a delay depending on who was asking for the report. It would help to have a person or a function where a BI person who knows the data structure can do the custom reports for all users. Put it in a format that can be brought into Excel and then the users can do the
Balanced scorecard and digital dashboard performance management systems are used alongside the BI module for tracking progress of the business strategies and deliverables. The scorecard identifies the company’s objectives and provides the metrics directed towards achieving goals. This includes benchmarking of KPIs and monitoring performance against benchmarks on an ongoing basis. The operations manager explained the utility of the scorecards: “the interesting features from the scorecard were to know what the budget was for the next six months, what were the firm orders, the planned orders, what were the gaps, where were the gaps coming from, and from which regions. So that the gaps could be taken up with those regions to ask for example, they had forecast for two million dollars and already had firm orders of 1.6 million, so where was the balance four hundred thousand going to come from. Those sorts of things, to make sure that budgets are being met and providing visibility to all concerned especially the salespersons in the regions to make them aware of the status”.

Digital dashboards provide executive management a snapshot of performance indicators to evaluate which areas are performing well and which ones are not. Each component of the dashboard represents a different business activity for tracking such as monitoring a revenue forecast. This would show what the revenue plan is for a period and the cumulative revenue achieved against the plan. Metrics could be selected from sales, operations, project management, or any other function the company wanted to monitor. The operations manager however, emphasized on the importance for currency of data used while monitoring metrics to measure effectiveness of business activities.

7. Discussion

The findings highlight the capabilities offered by BI tools to integrate enterprise-wide data and help managers build meta-knowledge. Data transformation from knowledge to meta-knowledge evolves with use of technologies and by adding experience, context, and interpretation as organizations apply business analytics to monitor their progress, measure performance, identify bottlenecks, and simulate multiple views of “what if” scenarios. Company managements make decisions assessing different outcomes by reviewing metrics captured via reporting techniques such as KPI, balanced scorecards, and digital dashboards.

Given the significance and risks faced in managing internal and external resources, this study has highlighted the utility of BI tools to map decisions with data assets. Various ES vendors/consultants and organizational user participants have answered the research question, which BI practices are most critical to the successful transformation of raw data into meta-knowledge?

A summary of BI practices that enable development of meta-knowledge and sharing of enterprise-wide information are: (1) analysis of current state through dynamic on-line queries which drill layers of data to inform management on which metrics to monitor, (2) understanding whether business strategy is aligned with operational strategy, (3) creation of user-friendly customized reports based on management needs and distribution to users, (4) access to a centralized data warehouse which integrate data feeds from various data marts, (5) simulations through different scenarios, and (6) transfer of data into other platforms (e.g., Excel) for further analyses. These functions help management understand process variations in volatile situations, intelligently plan better resource distribution, as well as initiate prompt actions.

Key findings highlight that BI tools are mostly used by sophisticated mature organizations, who have implemented ES for over three years. These organizations have already established active commitment of executives as well as users, and institutionalized performance measures. However, many organizations in New Zealand do not exploit the BI tools completely to maximize utilization of underlying information. Although, some improvements in strategy analysis have been realized with use of standalone spreadsheets software (e.g., Excel), findings reveal that BI tools have achieved a quantum leap in analytical capability and business reporting.

However, study findings emphasize that the BI tools must be tied to the middleware of the ES to extract the underlying data. To leverage BI technology, users must be able to drill into the core information as opposed to using it as a separate tool that only controls the data catalogs configured or specific data loaded into the system as found in the case of Bevon. This finding is consistent with Baptista et al.’s [8] study in which the organizational managements lost IT attention and its strategic value over time leading to increased business risk and under-exploitation. Overlooking of IT infrastructure can impact the holistic landscape of organizational processes that involves sharing of enterprise-wide information and monitoring of business activities. Data extracted by IT specialists provides a limited picture via ad-hoc reports opposed to impromptu generation of intelligence using BI.

Some of the common issues in the use of BI tools from the findings include: (1) mostly used as KPI reporting tool for measuring metrics instead of an analytical tool to achieve strategies, (2) usability by
select managers and not all users of ES for decision making, (3) data supply into BI tool instead of drill- down into middleware for information extraction, (4) integration of data from disparate sources being the responsibility of IT team instead of business managers, and (5) organizational discipline towards maintaining data quality.

Furthermore, practices considered critical for the data transformation process to produce organizational benefits were reviewed with case study participants. These empirical findings are categorized according to the five pre-existing contextual factors identified by Davenport [23] – strategic, organizational and cultural, skills and knowledge, data, and technology – that need consideration for achieving desired outcomes. The critical practices for leveraging BI to create knowledge and produce benefits are presented in Table 3.

This summary provides a comparative analysis of the cases, highlighting the current practices and the critical effectiveness constructs of the BI process. Managements have realized that effective utilization of BI capabilities lead to a deeper insight into the business dynamics for managing “environmental forces” of global markets. The analytical process originates from the setting of organizational vision, strategy, and targets. Once the business objectives are decided, these objectives drive the organizational new initiatives and process changes in support of their accomplishment as depicted by the downward pointing arrows in Figure 2.

Projects progressively utilize the BI system, which are the KM enablers for the purpose of managing knowledge-based processes such as KPI reporting and balanced scorecard to guide further actions. This process utilizes the firm’s knowledge assets, primarily, the ES data warehouse and its data. It is recognized that the existing technology can either deliver the identified requirement or might be limited by its ability to provide the precise information. This restriction could constraint the effectiveness and performance of the knowledge-based processes. The dotted upward arrows in Figure 2 represent this.

The data are extracted and utilized, initiated through the BI process for performance monitoring and management or a business function requirement that needs information for decision making. KM enablers such as the business intelligence system assist in analyzing extracted data for strategic decision making. The analytical processes lead to creation and utilization of meta-knowledge in various organizational projects, new initiatives, and process improvement programs to achieve the company’s goals and strategic benefits.

8. Conclusions and future directions

The study has highlighted an emphasis on identifying and improving the most critical practices for the BI process to build meta-knowledge. These critical practices get enabled when the BI process is deployed strategically to focus on measurement and monitoring of underlying issues. These practices impact the organizational ability to realize the business objectives. BI tools augment analytical metrics through measurable summary reports, graphical models, and tabular data.

### Table 3. Critical Practices for the BI Process to Build Meta-knowledge

<table>
<thead>
<tr>
<th>BI Practices context</th>
<th>Bevon</th>
<th>Cevon</th>
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<tbody>
<tr>
<td>Alignment to business strategy</td>
<td>Assessment of scope and budget through metrics</td>
<td>Visibility of goals to senior management via dashboards/KPIs</td>
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<tr>
<td></td>
<td>Clarity on project plans and deadlines</td>
<td>Clear definition of outcomes</td>
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<tr>
<td></td>
<td>KPI management</td>
<td>Phased project plans and deliverables</td>
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<tr>
<td>Change management</td>
<td>Retain knowledge from legacy systems (mySAP BI) as it upgrades to new tools (Business Objects)</td>
<td>Management must demonstrate the political will to support usage of ES data set for proactive decision making</td>
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<tr>
<td>Training</td>
<td>Impart usability training and build relationship with all stakeholders</td>
<td>Impart training and skills development to system administrators and BI users</td>
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<td></td>
<td>Collaboration of managers with IT specialists to maximize utilization of BI</td>
<td>Dedicated system administrator and local support</td>
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<tr>
<td>Data manipulation strategies</td>
<td>Analytical add-ons to include SQL queries, filters, cross-tabs, report features</td>
<td>Ability to transfer information into Excel spreadsheets for detailed analysis</td>
</tr>
<tr>
<td></td>
<td>IT specialists focus on maintaining high-quality of data cubes transported from BI</td>
<td>Data quality requisites are clearly defined within the built-in BI processes</td>
</tr>
<tr>
<td>Technology upgrades</td>
<td>Timely upgrade of appropriate technologies for better results</td>
<td>Use of appropriate tools and technology including their configuration</td>
</tr>
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</table>
A review process provides the means for a response through assessments supported by an underlying BI and data warehouse application. Assessments performed in areas such as production yields, inventory levels, quality parameters, manufacturing and test equipment utilization, planning and delivery targets, and operational costs assist to understand active data flows at discrete levels. A BI evaluation strategy allows functional metrics to align to the overall profitability objectives and deploy a contingency plan based on multiple “what ifs” using business process simulation techniques to investigate risks and opportunities. This enables the organization to increase operational efficiencies, maintain high product quality, and improve future versions of products. Further, business network partners (e.g., subsidiaries, distributors, key suppliers, and customers) capture vital information such as information on in-market sales and inventories that help in shaping demand and aligning supply.

Organizations continuously evolve by reviewing existing strategies to optimize and realize business value from their IT investment. A wrong decision may be as much disastrous as not taking the right decision timely. The price of a wrong decision in today’s competitive market is unforgiving. Timely decision making based upon information intelligence can be translated into making accurate projections for winning orders, providing services, and developing products. However, figuring out the right information to know is one of the trickiest, least understood, and the most important functions for this process.

Today’s BI technology provides a rational approach to business management, with the ability to extract relevant information from data repositories allowing analyses of performance and results distribution. Thus, BI practice continually leads to an ongoing process of continuous improvement to build meta-knowledge for insightful actions. Although this study was conducted in NZ, the findings will be of interest to organizations and ES/BI vendors across different regions of the world. Further research is suggested by replicating this study in other countries, especially utilizing the perspectives of the BI users in those countries to compare the findings with this study.

9. References


