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Measuring and evaluating KM capability in an organization

An exploratory case study

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Received 1 May 2013
Revised 1 October 2013
Accepted 8 November 2013

Abstract

Purpose – The purpose of this paper is to validate through a case study involving an organization in India, a five-phase Define-Identify-Build-Assess-Review methodology proposed for designing and implementing knowledge management capability (KMC) in an organization from a holistic perspective.

Design/methodology/approach – This paper adopts the case study approach, using semi-structured interviews and survey questionnaires to gauge KMC in the organization. Exploratory factor analysis and multiple regressions are applied to determine the impact of the chosen factors on KMC of the organization. Further, interpretive structural modelling is used to determine impact of selected variables on the business performance.

Findings – KMC of the organization is predominantly based on the "embedded routines", "knowledge base" and its "shared utilization" in the organization. The KMC is primarily driven through improved learning and rich explicit knowledge.

Research limitations – The study is confined to a specific business process in the organization. As the focus of study is based on a single organization, the generalization of the results to other organizations needs to be proven.

Practical implications – The periodical monitoring of the identified KMCs leads to enterprises making corrections and adjustments on the knowledge assets accordingly.

Originality/value – Introspection of the KMCs of the organization by the management in a holistic manner and bridging the operational gap by developing performance metrics.

Keywords KM capability, Measurement and evaluation, Business performance, Exploratory factor analysis, Multiple regression, Interpretive structural modelling

Paper type Case study

Introduction

The nature of the capabilities possessed by an organization differentiates it from others in the environment. Sony, with its innovative products, and Dell, with its supply chain, have created competencies which are difficult to replicate by their competitors. Competencies were identified as dynamic capabilities to stress the exploitation of existing internal and external firm-specific competences for addressing changing environments (Teece *et al.*, 1997). This view of knowledge as a capability, as opposed to a resource, recognizes that capabilities are firm-specific and embedded in the organization and its processes. Continually generating knowledge is among the major determinants of a firm's ability to develop and sustain core competencies, even when its competitive landscape undergoes radical change (Hamel and Prahalad, 1993, 1994).

Previous studies about how to improve knowledge management capability (KMC) efficiently are still controversial (Birkinshaw *et al.*, 2002). Most studies suggest that the

VINE: The journal of information and knowledge management systems
Vol. 44 No. 2, 2014
pp. 267-294

0305-5728
DOI 10.1108/VINE-05-2013-0026

activities of knowledge management (KM) sub-processes like organizational learning and knowledge integration will enhance KMC (Lee and Hong, 2002; Lin and Tseng, 2005). However, the interactions among these research variables are ignored in previous studies and require further research. When attempting to implement effective KM strategies, most organizations assume complete awareness of what knowledge-based resources they own and which elements of these need to be shared. However, such an assumption may not always be valid. Previous studies have been unable to present a general, universal framework for implementation in organizations and assessing impact of KMCs on business performance satisfactorily. Organizations wanting to deploy foundation technologies such as groupware, CRM or decision support tools, but failing to justify them on the basis of their contribution to KM, may find it difficult to get funding unless they can frame them within the KM context.

This study incorporates a five-phase DIBAR (Define-Identify-Build-Assess-Review) holistic methodology for designing and implementing KMC in an organization. The methodology consists of simple, comprehensive steps that can be readily understood across the organization and integrated with the organizational strategy. Validity of the proposed methodology DIBAR (Basu, 2013) is established with its application in the procurement process of an organization ABC, which is a leading player in its business sector. The procurement process incorporates varied functions like materials management, inventory control, value engineering and quality control, and serves as a good basis for performance measures in an organization. The scope of the study is limited to the KMC of the procurement process in ABC and its performance impacts at the strategic and operational levels of the organization. ABC is a reputed organization in India and the nomenclature so given is to respect the confidentiality aspect desired by the management in respect of data collected.

Literature review

In the resource-based view of the firm, internal resources and capabilities are the main source of competitive advantage, and firms should position themselves strategically based on their unique, inimitable resources and capabilities rather than on the external positioning of products and services derived from those capabilities (Prahalad and Hamel, 1990; Grant, 1991; Barney, 1996).

Existing KM frameworks do not easily suggest what KM interventions or investments an organization should make. Zack (1998) cites several field studies related to the motivating factors for KM projects (Davenport *et al.*, 1998; Ruggles, 1998), and states that the link between KM and business strategy, although frequently mentioned, has been widely ignored in practice.

Several researchers (Gold *et al.*, 2001; Lee and Choi, 2003; Desouza and Awazu, 2005) have examined KM from the perspective of organizational capabilities. Kaplan and Norton (1996) introduced balanced scorecard measures to create a mechanism linking long-term objectives into measurable metrics, emphasizing the relationship between investment and strategic plans. Lindsey (2002) defines KM effectiveness/success in terms of two main constructs: knowledge infrastructure capability and knowledge process capability. Knowledge infrastructure capability represents social capital while knowledge process capability represents the integration of KM processes into the organization. Liu *et al.* (2004) conducted an empirical study on the correlation between KMC and competitiveness in Taiwan's industries. Aujirapongpan *et al.* (2010) proposed

some indicators of KMC in different KM processes to assess KM effectiveness. KM assessment models and frameworks have also been proposed in other service sectors like government and faculty support organizations (Dzhusupova *et al.*, 2012; He and Abdous, 2013). Useful inputs have been gathered from Mithas *et al.* (2011), who developed a conceptual model linking IT-enabled information management capability with three important organizational capabilities (customer management capability, process management capability and performance management capability). Organizational factors affect KM practices differently in each country and KM activities need to be tailored to the organizational idiosyncrasies (Magnier-Watanabe *et al.*, 2011). Kruger and Johnson (2011), for instance, assessed the correlation between the successful institutionalization of KM and organizational performance in a developing economy (South Africa). Most of the models mentioned are prescriptive in nature. A summary of empirical studies carried out in the area of KMC is shown in Table I. The proposed model intends to eliminate subjectivity to the extent possible, while retaining all the important elements associated with managing knowledge in organizations.

Researchers like Porter (1985) have already identified the strategic importance of procurement and its recognition as a subject of performance management. The effective management of the procurement function yields benefits to the organization in terms of cost reduction, enhanced profitability, quality improvements and competitive advantage (Monczka and Trent, 1991; Porter, 1985). Versendaal and Brinkkemper (2003) categorized benefits derived into process-related (improved sourcing decisions) benefits, cost-related (reduced purchasing costs) benefits, quality-related (better product quality) benefits and organization-related (increased trustworthiness) benefits. The DIBAR model applied in this context can provide useful insights into the procurement performance characteristics of the organization.

Background of company ABC

ABC is a leading player in the chemical sector of India, operating mainly in industrial gases. The company has more than 20 production facilities spread over India, including one of Asia's largest air separation units. ABC has a history of more than 100 years built on a heritage of innovation with a strong focus on technology. ABC was converted into a public limited company in 1958 and rebranded itself in 2013 with their present name. ABC has around 1,000 employees as on 31 December, 2010, and enjoys harmonious industrial relations at all its plants and offices spread across the country.

ABC's business has two broad segments: gases and related products, and project engineering, in line with the operating model of its parent company based in Europe. The gases business is capital-intensive by nature, as it requires large investments in setting up of air separation units. The gases and related products segment comprises gases in bulk and packaged gases for industrial and healthcare segments. Gases in bulk consist of liquid oxygen, nitrogen and argon, and packaged gases consist of compressed industrial, medical, electronic and special gases. The supply chain in the gases business also requires significant investments in the form of distribution assets and storage networks to service bulk volumes at competitive prices. Cylinders are used to service relatively smaller volumes in packaged gases business, which includes special and electronic gases as well as gases in the healthcare business. The industry comprises large captive users in steel, fertilizer and refinery sectors and a number of merchant liquid customers primarily in metal, glass, automobile, petrochemicals and

Table I. Selected empirical studies on KM capability and firm performance

Sr. number	Author(s)	Factors	Firm performance measures	Results
1	Gold *et al.* (2001)	Infrastructural factors like technology, structure and culture are antecedents	Organizational effectiveness: ability to innovate, market response, etc.	There is a positive relationship between infrastructure and process capabilities and the firm performance
2	Lee and Choi (2003)	Infrastructural factors like culture, structure, people, information technology; KMC involves knowledge creation process (SECI)	Organizational creativity: novel ideas; organizational performance: compared with key competitors, profits, market share, etc.	Collaboration, trust, learning and centralization found to be "relatively significant predictors for knowledge creation". Knowledge creation is positively related with organizational creativity, which is positively related to organizational performance
3	Chuang (2004)	Structural, cultural, human and technical KM	Competitive advantage, innovativeness, market position, mass customization	Structural, cultural and human KM resources essential for competitive advantage
4	Tanrivedi (2005)	IT relatedness; KMC: creation, transfer, integrate and leverage	Tobin's q, ROA	IT relatedness of the firm's business units enhances cross-unit KMC; leads to superior firm performance
5	Freeze and Kulkarni (2007)	Knowledge capabilities are described in terms of their knowledge life cycle, tacit/implicit/explicit nature of knowledge, technology and organizational processes	Firm performance	Knowledge capability are presented and described as expertise, lessons learned, policies and procedures
6	Chan and Chao (2008)	Technology, structure, culture, acquisition, conversion, application, protection	Infrastructural capability, process capability	Balanced combination of management support, technology and organizational factors essential to build KM capability in SMEs

(continued)

Sr. number	Author(s)	Factors	Firm performance measures	Results
7	Chang and Tzen (2010)	Dynamic capability, potential absorptive capability, realized absorptive capability	Innovation performance	Applied multiple criteria decision analysis method-DEMATEL, to examine knowledge management capabilities in high-tech industry
8	Kaplan and Norton (1996)	Financial, customer, learning and growth, internal business process	Balanced scorecard	Align unit and individual goals with the strategy
9	Aujirapongpan *et al.* (2010)	Resource-based perspective (technology, structure and culture); and a knowledge-based perspective (expertise, learning and information)	KM effectiveness	Lack of precision in developing KMC to achieve its effectiveness
10	Mithas *et al.* (2011)	Customer management capability, process management capability, and performance management capability	Firm performance	The three capabilities mediate the relationship between information management capability and firm performance
11	Kruger and Johnson (2011)	Average KM maturity	Organizational performance	Positive correlation
12	Dzhusupova *et al.* (2012)	Demand-side KM needs and supply-side KM capabilities	KM capability	Demand/supply KM in government
13	He and Abdous (2013)	Knowledge-centred support (KCS) framework	Faculty support and service innovation	KM approach increases service quality and innovation

Table I.

pharmaceutical sectors. New applications in segments like oil and gas, food freezing, refrigeration, fire suppression, solar photovoltaic, etc. continue to provide growth opportunities. The project engineering segment comprises the business of designing, supply, installation and commissioning of tonnage air separation units of medium to large size, apart from projects relating to setting up of nitrogen plants, hydrogen pressure swing adsorption plants and gas distribution systems. The project engineering division also manufactures cryogenic and non-cryogenic vessels for in-house use as well as for sale to third-party customers.

ABC develops forward-looking products and technologies that support diverse industries as part of their strategy to maintain leadership in the gases market in India. SHEQ (safety, health, environment and quality) is a prerequisite to any business that they undertake and underpin all their decisions, actions and behaviours. ABC has a well-established SHEQ management system, which is clearly communicated and reinforced to ensure their compliance by employees and contractors alike. Their strong technology base, backed by global best practices of their parent group, enables them to create value-added solutions tailored to the business requirements of their customers. ABC fosters a working environment where ethical conduct is highly valued and enforced by putting in place strong governance measures and transparent practices, creating a conducive working environment for its employees.

As the gases business involves transporting large volume of liquid products in transport tankers to customers spread across the country, this has been an area of ever increasing focus in the company. The innovative use of gases has transformed production methods in different industrial segments, such as metals, chemical and petrochemical production, food processing, medical health care, electronics and environment control. ABC's support to such industries is possible due to its rich resource base consisting of South Asia's largest air separation units, a world-class special gases filling and monitoring centre, a dedicated fleet of tankers and more than 100 dealers spread evenly across India, providing a geographic reach beyond compare.

The procurement process in ABC

The procurement process in ABC is centralized on an ERP platform, which is operational since 1998. The majority of the procurements follow the traditional pattern consisting of the following steps:

- checking requisitions from the indentors;
- securing quotations;
- analysing quotations;
- vendor selection;
- issuing purchase orders;
- following up for delivery;
- checking receipt of materials;
- verifying invoices; and
- making payment.

Besides the aforementioned activities, other assignments involving procurement in ABC can be categorized as follows:

- *Basic information:* Maintaining procurement records, price records, stock and consumption records, supplier records, specification files and catalogue files.
- *Materials management:* Maintaining minimum stocks and inventory balance, improving cylinder turnover, transferring materials, consolidating requirements, avoiding excess stocks and obsolescence, standardization programmes, price negotiations, purchases involving import of materials, accounting for returnable materials and making periodic reports of purchase plans or commitments.
- *Research activities:* Conducting market studies, material studies, cost/price analysis, value analysis, investigating supply sources, developing supply sources and developing alternate materials.
- *Miscellaneous activities:* Making cost estimates, disposing of scrap, obsolete and surplus materials.
- *Auxiliary functions:* Responsibilities shared with other departments like standardization, specifications, make or buy decisions, substitution of materials, acceptance testing, inventory control, logistics, materials budget, selection of capital equipment and project-specific purchases.

The issues in the procurement process of ABC are discussed in the next section with reference to the proposed DIBAR methodology. The management would like to have a methodology by which the knowledge capability within the process can be gauged for self-assessment and control. In the absence of such an assessment methodology, the requirement is attempted to be met by the DIBAR methodology.

Data collection and analysis

Procurement function is a vital function in any organization with strategic implications on the bottom line of the company. Features like the quality of materials sourced, the supplier base developed (including international markets) and the art of negotiating prices differentiate the capabilities of an organization from another. The DIBAR methodology is applied step-by-step to understand the KM effectiveness of the procurement process, so essential for understanding the organization's capabilities with respect to the knowledge aspects of the procurement process. Each step in DIBAR has measurable outputs by which the KMC of the procurement process is evaluated at strategic and operational levels. The feedback from these steps helps the management to identify the knowledge gaps in the process and review the KM process in the next cycle.

Step 1: Define

Flowcharting the procurement process in ABC was the first stage for defining the problem (Figure 1). A brainstorming session was arranged in the premises of ABC to critically examine the KM aspects in the procurement process. The brainstorming group consisted of three academicians, one research scholar and four senior management representatives from ABC. The academicians were professors from reputed institutes of the country, while the four management representatives had more than 20 years of experience individually. Two of them were part of the ABC procurement team, while the other two were primarily from the areas of finance and engineering.

Based on individual assessment and discussion with ABC representatives, the external team of academicians and researcher identified three problem areas each.

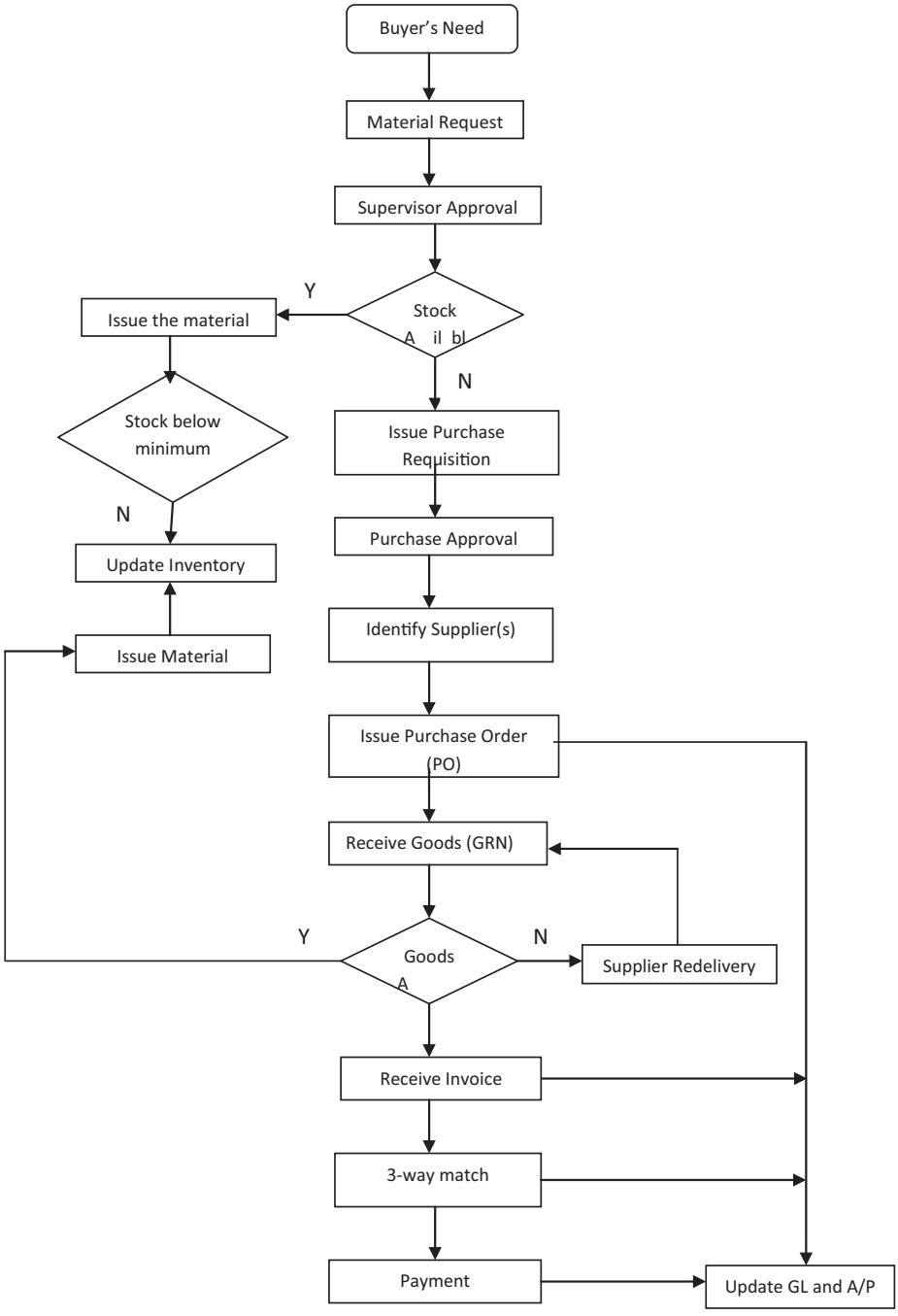

Figure 1.
Procurement process in ABC

These problems were then discussed with the management and a set of possible problem areas defined for the process shown in Figure 2. The problems identified related to coordination issues with other entities within and outside ABC and improper planning of activities. The root cause for such problems was the lack of proper mechanism for knowledge transfer and integration into the process. In the second round, the individuals ranked these problems according to their criticality. A summated score was compiled for each problem area identified to define the most critical problem, which was assessed to be the capability for managing knowledge within the procurement process in ABC. The Ishikawa diagram (Figure 2) was then used to identify the root cause of the problem, which was found to be related to the process (rush or emergency orders, late deliveries by suppliers and delays in payment to suppliers) or people (lack of time to document and lack of cross-disciplinary training).

Another round of brainstorming session was carried out to specifically determine the factors (causes) of KMC considering the size and age of the organization. The factors identified at the end of two rounds were related to knowledge processes (creation, dissemination, storage and application), product and supplier information and the infrastructural ability or maturity of the organization. The organization-and sector-specific influences were collated by the management for the defined problem. The necessary condition for adoption of the DIBAR model, KM maturity level $L_k \geq 2$, k=1 […] […]. 5 is fulfilled, considering factors like perceived work environment and information and communications technology (ICT) infrastructure of ABC.

Hence, the factors identified, viz., ICT, culture, structure, information, knowledge creation, knowledge storage, knowledge dissemination, knowledge application and industry-specific factors, were similar to the proposed factors in DIBAR.

The next step involved defining a target metric for KMC by the senior managers through subjective rating on each of the given parameters. The factors and its associated strengths or weaknesses in the context of the process were discussed among the senior management, before specifying it at the strategic level. Earmarking the target is a crucial step in the define phase, as it establishes an internal benchmark for the

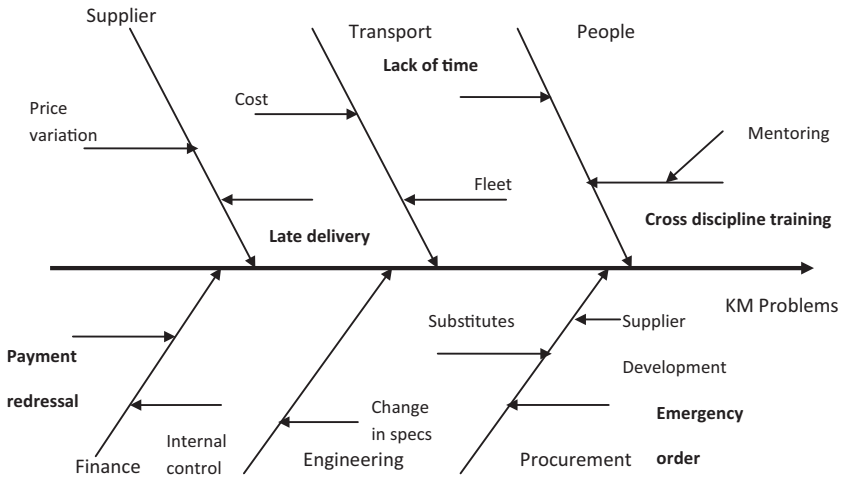

Figure 2.
Ishikawa diagram for KM problems in ABC

process at all levels in the organization, which could have ramifications on diverse issues like productivity and incentive schemes in the organization.

The senior management team, in consultation with the external team, proposed not to assign any initial weightage to the factors, considering that such an exercise was not carried out earlier. Due to lack of data from previous experiences, the study was considered to be an exploratory one. However, the subjective individual ratings of the management team on the eight factors were compiled on a scale of (1-7) and the mean computed.

The ratings by the team on the factors and the target metric specified are shown in Table II. Summarizing, outputs from this phase are the mean scores of factors X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8 and X_9 as computed. It is found that KM target metric is 6.41 (average of the individual factor scores). It is also assumed that KM maturity level is L_3.

Target metric specified: 6.41. … (A)

Step 2: Identify

The integrated ERP system operating in company ABC on SAP ECC Ver 6.0 links the MM component, serving as the backbone for all procurement-related transactions, with other functionalities like finance, sales, production and human resources. The personnel responsible for the activities in the procurement process are identified, while the knowledge objects associated with the process (requisition forms, quotation, purchase order, etc.) are either generated from the ERP system or are embedded within it. The ERP system maintains a log of the persons accessing the process at any time through their authentication ID and password, thereby ensuring security and internal control over the entire process.

A survey questionnaire is designed to capture the data for examination of the knowledge processes followed for the procurement process in ABC. The data can be either public (available for all) or private (restricted or personal). The questionnaire is divided into two parts: Part A and Part B. In Part A, items related to the personal details of the respondents, their specific work area and experience are mentioned. Part B contains questions of different types related to the research issues, which were assessed using a 7-point Likert scale (where 1 = strongly disagree and 7 = strongly agree). Respondents were asked to provide their opinions about statements made in the questionnaire. Before sending out the final version of the questionnaire, a pilot test was conducted to check the syntax and resolve semantic problems related to the content.

The questionnaire contained 38 items, which were used to measure nine variables and construct the relationships among them. All the measured items are shown in the Annexure and the results are coded in MINITAB 15.0 for Windows. The sub-factors or measurement variables corresponding to each of the factors are identified from past

Table II.
Specification of target metric

Factors experts	ICT (X_1)	CUL (X_2)	STR (X_3)	INF (X_4)	KC (X_5)	KS (X_6)	KD (X_7)	KA (X_8)	IND (X_9)
1	6	6	6.5	6.5	6	7	6	6.5	6
2	7	6.5	7	7	6	7	6.5	6.5	6.5
3	6.5	6	6.5	7	6	6.5	6	6.5	6
4	6	6.5	6.5	6.5	6	7	6	6.5	6
Mean score	6.40	6.25	6.63	6.75	6.00	6.88	6.13	6.5	6.13

literature and reviewed by an expert group consisting of academicians and practitioners. Based on their recommendations, a few modifications were made before administering the questionnaire for pre-testing among another set of academicians and practitioners in ABC. Certain modifications in the language and deletion of items yielded the final set of items depicted in Table III.

Data were collected from employees within the procurement department of ABC through a questionnaire survey. The questionnaires were distributed to all employees from different positions and functional areas within the organization through the head of the procurement department within the organization. A covering letter explaining the purpose of this study was attached together, assuring them of the confidentiality of their responses and instructing them to complete the questions, seal and return the completed questionnaires using the attached envelope. A total of 330 questionnaires were distributed and 138 employees responded (an initial response rate of 41.8 per cent) for Part A and Part B consisting of the research issues. Seven questionnaires were discarded because of missing data and problematic response patterns, obtaining 131 usable questionnaires (a final average response rate of 39.7 per cent). There were 109 male and 22 female respondents. Age was not disclosed by a large section of the respondents.

Sr. number	Factor	Sub-factors
1	ICT (X_1)	Availability of ICT infrastructural tools (X_{11}), speed or response time (X_{12}), ease of operation or user-friendliness (X_{13}), system maintenance (X_{14}), system use (X_{15})
2	Culture (X_2)	Perceived work environment (X_{21}), commitment to learning (X_{22}), senior management commitment (X_{23}), training and development (X_{24}), freedom to explore and experiment (X_{25})
3	Structure (X_3)	Degree of formalization (X_{31}), satisfaction with incentive scheme (X_{32}), frequency of use of manuals or documents (X_{33}), rigidity in process/ procedures (X_{34}), degree of satisfaction with the artifacts available (X_{35}), degree of responsiveness of the organization (X_{36})
4	Information (X_4)	Quality of information on customer or supplier (X_{41}), market or competitor(X_{42}), product or service (X_{43}), process (X_{44}), employee (X_{45}), financial (X_{46})
5	Knowledge creation (X_5)	Socialization (X_{51}), externalization (X_{52}), internalization (X_{53}), combination (X_{54})
6	Knowledge storage (X_6)	Storage (X_{61}), codification (X_{62}), maintenance (X_{63}), retrieval (X_{64})
7	Knowledge dissemination (X_7)	Absorption (X_{71}), diffusion (X_{72})
8	Knowledge application (X_8)	Integration (X_{81}), leverage (X_{82})
9	Industry and environment (X_9)	Size of organization (X_{91}), position in life cycle/age (X_{92}), competitiveness within sector (X_{93}), economic climate (X_{94})

Table III.
Measurement variables for DIBAR

The study being knowledge-related, only experienced graduates working in the organization were considered eligible for responding to the questionnaire. As the questions included comparisons on various factors *vis-à-vis* five years back, an additional rider imposed was that the executive should have minimum five years of work experience in the organization. The survey was conducted over a two-month period in which several visits were made to ABC for interaction with senior management and collecting the questionnaires. Table IV provides summarized information about the respondents' demographics, showing the sample to be a representative one.

The 22 business performance measures to gauge KMC are given in Table V. The respondents give their feedback on each performance-related criterion, depending on whether they consider the criterion to be important or effective in respect to their organization. Table V provides the responses of the employees on a scale of (1-7) to the various criteria as selected.

It is observed that the sample mean value of the "effectiveness" dimension is less than the sample mean value of "importance" dimension for all criteria. This may indicate that respondents are relatively unsure about the effectiveness of each criterion. The distribution can be segmented into three distinct clusters on the basis of the mean computed for the set of criteria.

The first cluster consists of eight criteria identified as the most important and most effective by the respondents from ABC. These eight criteria are as follows (computed mean ≥ 6 for each):

(1) improved business process;

(2) improved learning;

(3) enhanced product service/quality;

(4) improved productivity;

(5) increased innovation;

Measure	Items	Frequency	Per cent
Gender	Male	109	83.2
	Female	22	16.8
Age	≤30	28	21.4
	31-40	40	30.5
	41-50	17	13.0
	>50	15	11.5
	No response	31	23.6
Education level	Graduates only	91	69.5
	Postgraduates	40	30.5
Seniority level	Junior (Executive/Sr. Executive)	66	50.4
	Middle level (Manager/Sr. Manager)	48	36.6
	Senior level (DGM and above)	17	13.0
Work experience	5-10 years	26	19.8
	10-20 years	55	42.0
	20-30 years	37	28.2
	>30 years	13	10

Table IV.
Demographics of respondents

Sl. No.	Business performance statement	Importance	Effectiveness	Mean
1	Increased profits	6.46	6.06	6.26
2	Reduced costs	6.20	6.08	6.14
3	Improved productivity	6.28	5.94	6.11
4	Better staff attraction or retention	5.23	5.01	5.12
5	Improved return on investment	5.43	5.23	5.33
6	Increased share price	5.35	5.25	5.30
7	Faster response to key business issues	6.18	6.06	6.12
8	Creation of new business opportunities	4.64	4.58	4.61
9	Improved new product development	5.21	5.05	5.13
10	Improved business processes	6.15	6.11	6.13
11	Increased market size	5.82	5.70	5.76
12	Increased market share	5.88	5.72	5.80
13	Better decision-making	5.90	5.60	5.75
14	Creation of more value to customers	5.18	4.98	5.08
15	Entry to different market	5.37	5.13	5.25
16	Enhanced service or product quality	6.18	6.00	6.09
17	Better customer handling	4.79	4.65	4.72
18	Enhanced intellectual capital	4.88	4.62	4.75
19	Increased innovation	6.11	5.95	6.03
20	Improved learning/adaptation	6.26	5.98	6.12
21	Increase in product variety	5.03	4.81	4.92
22	Increase in process variations	4.99	4.77	4.88

Table V.
Importance and effectiveness rating of business performance variables

(6) increased profit;
(7) faster response to business issues; and
(8) reduced costs.

The next seven criteria are as follows (computed mean between 5 and 6):

(1) increased share price;
(2) improved return on investment;
(3) improved new product development;
(4) increased market size;
(5) increased market share;
(6) better decision-making; and
(7) creation of more value to customers.

The final cluster of seven criteria is as follows (computed mean ≤ 5):

(1) better staff attraction or retention;
(2) creation of new business opportunities;
(3) entry to different market;
(4) better customer handling;
(5) enhanced intellectual capital;

(6) increase in product variety; and
(7) increase in process variations.

Summarizing, outputs from this phase are the sub-factors $X_{1(1\text{-}5)}$, $X_{2(1\text{-}5)}$, $X_{3(1\text{-}6)}$, $X_{4(1\text{-}6)}$, $X_{5(1\text{-}4)}$, $X_{6(1\text{-}4)}$, $X_{7(1\text{-}2)}$,$X_{8(1\text{-}2)}$ and$X_{9(1\text{-}4)}$ (a total of 38 sub-factors), where, for example, $X_{1(1\text{-}5)}$ indicates the five sub-factors of factor X_1 and so on. The eight business performance parameters deemed to be most important and effective are also identified in this phase.

Step 3: Build

The descriptive statistics (in terms of mean and standard deviation) for the nine factors, constituting a total of 38 sub-factors, are given in Table VI for a sample size of 131 (number of respondents $N = 131$).

The descriptive statistics of the KMC factors establish the normality of all the factors with Cronbach's alpha equal to 0.58.

Following the steps in the build phase, factor analysis is conducted on the eight factors as identified into a smaller set of composite variates. It is difficult to control a large number of performance factors and the industry practitioners ideally like to have a smaller number of factors for monitoring and control. Hence, there is need for reduction of the factors to two to three manageable ones. These representative variables can then be used subsequently in multivariate analyses, using representative factors, factor scores or summated scales. Besides the requirements of linearity, normality and homoscedasticity, the appropriateness of factor analysis is justified by some degree of multicollinearity between some factors like X_4, X_5 and X_6, as shown in Table VII.

Sample size considered for the study is 131, which is adequate at 0.05 significance level, considering a 10:1 ratio with respect to the number of variables to be analysed (Hair *et al.*, 2006). The appropriateness of factor analysis for this study was determined by Kaiser–Meyer–Olkin Measure of Sampling Adequacy at 0.661, considered to be acceptable for the next stage. Factor analysis using principal components is used to determine the number of factors to be extracted through the latent root criterion (eigenvalues greater than 1) and per cent of variance criterion (achieving a specified cumulative percentage of total variance extracted by successive factors).

The initial unrotated factor matrix is computed, containing the factor loadings for each variable on each factor as shown in Table VIII. Looking at the communality column in the extreme right of Table VIII, X_7 and X_9 have very low communality and also do not show significant loading (< 0.50 for $n = 131$) on any factor. Hence, X_7 and X_9 may be

Table VI.
Values for KM capability factors (mean and standard deviation)

Sl. No.	Factor	Mean	SD
1	X_1(ICT)	5.22	0.35
2	X_2(CUL)	5.13	0.38
3	X_3(STR)	5.56	0.42
4	X_4(INF)	5.38	0.42
5	X_5(KC)	4.80	0.34
6	X_6(KS)	5.36	0.45
7	X_7(KD)	5.02	0.65
8	X_8(KA)	5.86	0.61
9	X_9(IND)	4.90	0.82

considered for deletion and the factor model respecified by subjecting the resultant factor matrix to varimax orthogonal rotation, resulting in Table IX, the per cent variance increasing to around 73 per cent as a result.

Interpreting the complex interrelationships represented in the rearranged factor matrix shown in Table IX involves the following steps:

- All variables have high loadings on a single factor (no cross-loadings) ensuring an optimal structure.

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
X_1	1.00								
X_2	0.04	1.00							
X_3	0.24	0.17	1.00						
X_4	0.19	0.03	0.01	1.00					
X_5	0.11	0.01	0.01	0.80	1.00				
X_6	0.18	0.05	0.03	0.91	0.86	1.00			
X_7	0.09	0.05	0.08	0.28	0.36	0.30	1.00		
X_8	0.04	0.12	0.01	0.01	0.05	0.01	0.02	1.00	
X_9	0.08	0.18	0.11	0.10	0.07	0.04	0.03	0.09	1.00

Table VII. Correlation matrix for KM capability factors

Variable	Factor 1	Factor 2	Factor 3	Communality
X_1	−0.218	0.752	−0.221	0.662
X_2	0.015	0.342	0.645	0.534
X_3	−0.026	0.725	−0.043	0.528
X_4	0.948	−0.006	−0.027	0.899
X_5	0.920	0.062	−0.002	0.851
X_6	0.970	0.033	0.007	0.941
X_7	0.450	0.210	−0.112	0.259
X_8	0.016	0.000	0.782	0.612
X_9	0.310	−0.180	0.232	0.361
Variance	2.9356	1.2565	1.0929	5.2851
Per cent Var	36.7	15.7	13.7	66.1

Table VIII. Initial unrotated factor loadings, communalities and variance

Variable	Factor 1	Factor 2	Factor 3	Communality
X_6	0.983	−0.038	−0.018	0.968
X_4	0.960	−0.065	0.026	0.927
X_5	0.921	−0.024	−0.022	0.849
X_3	0.079	0.791	−0.068	0.637
X_1	−0.170	0.753	0.044	0.598
X_8	−0.008	−0.156	−0.763	0.606
X_2	0.015	0.182	−0.714	0.543
Variance	2.7716	1.2566	1.0998	5.1281
Per cent Var	39.6	18.0	15.7	73.3

Table IX. Sorted factor loadings (varimax), communalities and variance

- All variables have communalities exceeding 0.50, ensuring their retention in the analysis.
- Variables X_4, X_5 and X_6 load highly on Factor 1, and variables X_1 and X_3 load significantly on Factor 2, while Factor 3 is characterized by high loadings of variables X_2 and X_8.
- X_4, X_5 and X_6 are combined to be labelled as knowledge base (KB), X_1 and X3 are referred as embedded routines (ER) and factors X_2 and X_8 represent shared utilization (SU) of knowledge. Information as an explicit type of resource combined with the tacit intellectual capital of the knowledge managers helps in creating a repository of organizational memory, which is a source of knowledge updation for the employees. The information, knowledge creation and storage ability is referred as "knowledge base"', contributing to the KMC of the ABC. The organizational procedures, routines and practices are implemented through the ERP system, which requires IT support and maintenance for its sustainability. The ICT and structural factors together are called "embedded routines"' due to the large-scale dependence on ICT for carrying out routine activities. Finally, application of the vast knowledge in ABC by sharing across departments is only possible if there is an organizational climate which does not encourage hoarding of knowledge. The cultural and knowledge application factors combine to form a new factor, called "shared utilization". These three new factors represented by KB, ER and SU account for the explanation of more than 73 per cent of the total variance, considered very satisfactory in such studies.

Validation of factor analysis

For validation of the factor analysis result, the sample is split into two equal samples of 65 respondents and the factor models estimated to test for comparability. Tables X and XI contain the varimax rotations for the split samples, along with the communalities. Both the tables are comparable in terms of both loadings and communalities for all seven factors, ensuring the stability of the results obtained from the sample.

In selecting a single variable to represent an entire factor, it is preferable to use an orthogonal rotation so as to ensure that, to the extent possible, the selected variables be uncorrelated with each other. Attention is on the magnitude of the factor loadings, irrespective of the sign. The surrogate variables chosen from Table IX for KB, ER and SU are X_6, X_3 and X_8, respectively.

Summarizing, outputs from this phase are the reduced factors KB, ER and SU essential for assessment of KMC for the process.

Table X.
Sorted rotated factor loadings and communalities (split sample 1)

Variable	Factor 1	Factor 2	Factor 3	Communality
X_4	0.817	−0.128	−0.048	0.687
X_5	0.778	0.336	0.046	0.721
X_6	0.762	−0.278	−0.178	0.690
X_3	−0.249	0.760	−0.267	0.710
X_1	0.053	0.732	0.220	0.588
X_8	0.019	−0.209	−0.768	0.634
X_2	0.157	0.383	−0.613	0.548

Step 4: Assess

This step consists of assessing the relationship between the identified variables (designated as KB, ER and SU henceforth) and the KMC, interpretation of public or private data available and displaying the same through charts or reports. Multiple regressions with respect to the DIBAR methodology are used to determine the relative importance of each independent variable and their interrelationships in the measurement of KMC. The following specific issues are addressed in this phase:

The sample size of 131 is considered to be more than adequate for the study. The default value of the confidence level is set at 95 per cent while assessing the results. The assumptions apply both to the individual variables (dependent and independent) and to the relationship as a whole in the following areas: linearity, constant variance of the error terms, independence of the error terms and normality of the error term distribution. Also, there are no intercepts, as KMC = 0 when all the other variables are equal to zero, and standardized regression equation explains the relative importance of the independent variables with respect to the dependent variable.

As the set of independent variables is exactly specified in the build stage, the confirmatory approach is used to specify the regression model. Two sets of independent variables corresponding to surrogate variables derived from the build stage are used for estimating the dependent variable, KMC. Table XII depicts the regression equation considering the surrogate variables, resulting in Equation KMC = 0.265KB + 0.711ER + 0.166SU. Here, the predictor variables are considered to be equivalent to the original variables having the maximum loading on that factor.

Variable	Factor 1	Factor 2	Factor 3	Communality
X_6	0.983	−0.010	−0.035	0.968
X_4	0.973	0.004	−0.004	0.948
X_5	0.940	−0.043	−0.009	0.886
X_2	0.067	−0.807	−0.229	0.709
X_8	−0.002	−0.647	0.193	0.456
X_3	0.124	0.111	0.890	0.820
X_1	−0.365	−0.345	0.541	0.545

Table XI. Sorted rotated factor loadings and communalities (split sample 2)

Predictor	Coefficient	SE coefficient	*T*	*P*
KB	0.265	0.120	2.20	0.029
ER	0.711	0.143	4.96	0.000
SU	0.166	0.094	1.76	0.051
S = 0.7445				PRESS = 74.28
Analysis of variance				

Source	DF	SS	MS	*F*	*P*
Regression	3	4428	1476	2662.58	0.000
Residual error	128	71	0.6		
Total	131	4499			

Table XII. Regression on KMC

The result shows significant effect of KB, ER and SU at 0.05 significance level on KMC. Interaction effects and multicollinearity problems are ruled out, as it had been pre-processed at the build stage for inter-corelationships. The R^2 value of 0.98 implies very good fit, while there is no influential observation or outlier noticeable. The Durbin–Watson statistic of 1.33 indicates that there is no significant autocorrelation effect existing in the model. The result can be validated using PRESS (predicted error sum of squares) statistic, which should not be less than SSE (sum square of errors), but close to it (Fredrick, 2001). The normal probability plot and histogram plot substantiate the assumptions made earlier on the linearity and normality aspects of the variables considered for regression.

Actual metric obtained from survey: 5.82 … (B)

KMC and business performance

The relationship of KMC with respect to the business performance measures is next examined with reference to the case. In each case, KMC is the independent variable, while the business performance attribute is the dependent variable. Interpretive structural modelling (ISM) is a method which can be applied to a system to better understand both direct and indirect relationships among the system's components. The application of these approaches is widely accepted as a vital step in developing testable hypotheses and measurable objectives and, ultimately, to formulating effective approaches to problem solving. ISM was used to interpret the response obtained from the questionnaire with respect to the criteria identified for the procurement process in ABC. This analytic approach is used to uncover the "shared mental model" associated with the favoured criteria identified from the survey. The results from ISM are used to draw managerial and theoretical implications associated with the findings from KMC constructs. KM efforts have internal focus and have an indirect impact on the bottom-line results, which is explained through ISM analysis. The steps involved in ISM are as follows:

- The top eight attributes of business performance ranked by the respondents are chosen for analysis and shown in Table XIII.
- The contextual relationship between the attributes specified is "leads to".
- The self-structured interaction matrix as computed from the given data is shown in Table IV (V: $C_i > C_j$; A: $C_j > C_i$; X: $C_i \sim C_j$; O: $C_i >< C_j$).
- The reachability matrix as computed from the given data is depicted in Table XV.

Number	Factor description
1	Improved business process
2	Improved learning
3	Enhanced product/service quality
4	Improved productivity
5	Increased innovation
6	Increased profit
7	Faster response to business issues
8	Reduced costs

Table XIII.
Factors for ISM

- Level partitioning is done to classify the elements into different levels of the ISM hierarchical structure as shown in Table XVI.
- The ISM is generated by replacing all criterion numbers with the actual attributes, giving a clear picture of the performance factors and the flow of relationships as depicted in Figure 3.

Figure 3 portrays the direct and indirect relationships between the factors determining KM outcome in ABC. A business process is defined as "a set of logically related tasks performed to achieve a defined business outcome" (Davenport, 1995). It is observed that improved learning is the key driver leading to improved business process and enhanced product/

Number	Factor description (C_i) (C_j)	8	7	6	5	4	3	2	1
1	Improved business process	V	V	V	V	V	X	X	X
2	Improved learning	V	V	V	X	V	V	X	
3	Enhanced product/service quality	O	X	V	X	V	X		
4	Improved productivity	X	V	V	V	X			
5	Increased innovation	X	V	V	X				
6	Increased profit	X	O	X					
7	Faster response to business issues	O	X						
8	Reduced costs	X							

Table XIV. Structural self-interaction matrix (SSIM) for KM criteria

Number	Factor description	1	2	3	4	5	6	7	8	DP[a]
1	Improved business process	1	1	1	1	1	1	1	1	8
2	Improved learning	1	1	1	1	1	1	1	1	8
3	Enhanced product/service quality	1	0	1	1	1	1	1	0	6
4	Improved productivity	0	0	0	1	1	1	1	1	5
5	Increased innovation	0	1	1	0	1	1	1	1	6
6	Increased profit	0	0	0	0	0	1	0	1	2
7	Faster response to business issues	0	0	1	0	0	0	1	0	2
8	Reduced costs	0	0	0	1	1	1	0	1	4
DP[b]		4	3	5	5	6	7	6	6	

Notes: [a]DP: Driving power; [b]DP: dependence power

Table XV. Reachability matrix to KM criteria

Factor	Reachability set	Antecedent set	Intersection	Level
Improved business process	1, 2, 3, 4, 5, 6, 7, 8	1, 2, 3	1, 2, 3	III
Improved learning	1, 2, 3, 4, 5, 6, 7, 8	1, 2, 5	1, 2, 5	IV
Enhanced product/service quality	1, 3, 4, 5, 6, 7	1, 2, 3, 5, 7	1, 3, 5, 7	III
Improved productivity	4, 5, 6, 7, 8	1, 2, 3, 4, 5, 7, 8	4, 5, 7, 8	II
Increased innovation	2, 3, 5, 6, 7, 8	1, 2, 3, 4, 5, 8	2, 3, 5, 8	II
Increased profit	6, 8	1, 2, 3, 4, 5, 6, 8	6, 8	I
Faster response to business issues	3, 7	1, 2, 3, 4, 5, 7	3, 7	I
Reduced costs	4, 5, 6, 8	1, 2, 4, 5, 6, 8	4, 5, 6, 8	I

Table XVI. Level partitioning

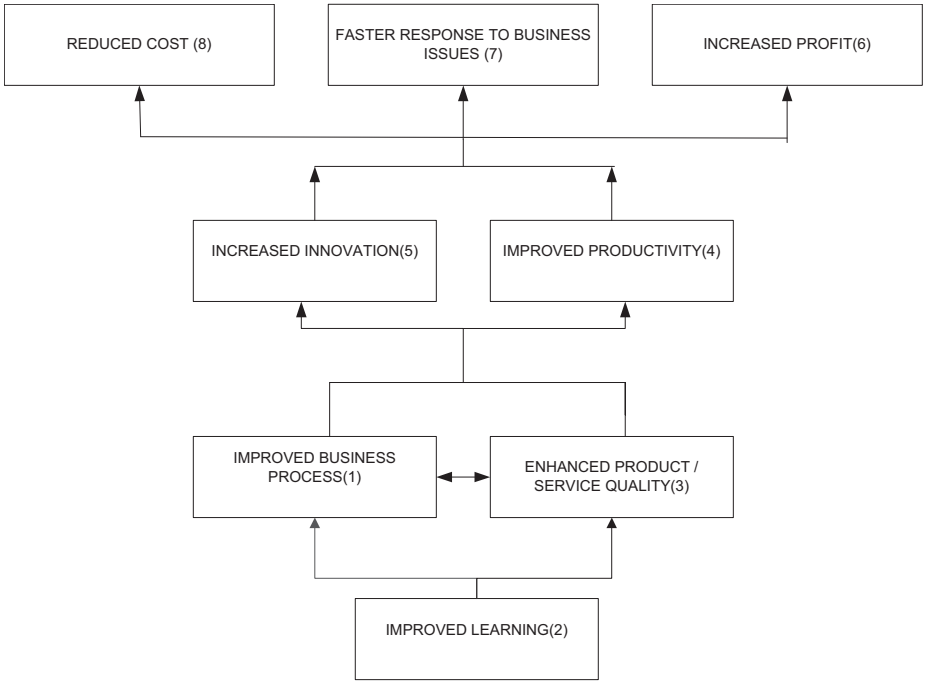

Figure 3.
ISM levels

service quality. This corroborates with the double-loop learning proposition by Argyris and Schon (1978). An improved learning environment in the organization also helps in enhancing the product or service quality (Anantatmula, 2007). It is also observed that improved business process and enhanced product/service quality co-influence each other, resulting in increased innovation and improved productivity of the process in all likelihood. Innovation is defined as "the process by which varying degrees of measurable value enhancement is planned and achieved in any commercial activity and the process may be radical or incremental" (Nelson and Winter, 1982). Innovation can be achieved by introducing new/improved goods/services, implementing new/improved operational processes and/or implementing new/improved business processes. The outcomes of an innovative process may result in faster response to business issues, reduced costs and increased profits. Aligning KMCs with the strategic plan of an organization would direct KM efforts towards improved organizational performance, such as reduced costs, increased market share and profits. Together, all the attributes of a learning environment and enhanced service quality ultimately may lead to transforming organizations' activities in terms of faster response to business issues.

To promote individual learning, an employee's performance should be linked to business goals. A learning environment promotes employee development using effective KM tools, resulting in employees acquiring critical process skills. Likewise, productivity results should be measured by developing metrics and benchmarks. The results suggest that KM attributes can be linked to improved business performance, leading to better bottom-line results.

The ISM chart (Figure 4) is constructed by plotting the dependence power and the driving power of the selected performance attributes obtained from Table XVII.
A critical examination of the chart reveals that there are no attributes present in the "Autonomous'" quadrant, implying that all the attributes chosen have considerable impact on the business performance and require serious managerial consideration. Nurturing of relatively intangible KM factors identified in Levels III and IV would lead to better control of relatively tangible KM factors identified in Levels I and II. The "Dependents", viz., reduced cost, faster response to business and improved profits, are akin to lag indicators and considered to be of strategic importance to the organization ABC. Improved learning happens to be the key "driver" for knowledge-related activities in ABC, while improved business process, improved productivity, increased innovation and enhanced product/service quality are akin to lead indicators, which monitor the performance over a shorter time frame. While the long-term goals of the company focus on the "Dependents", it is important for any organization to set milestones over shorter

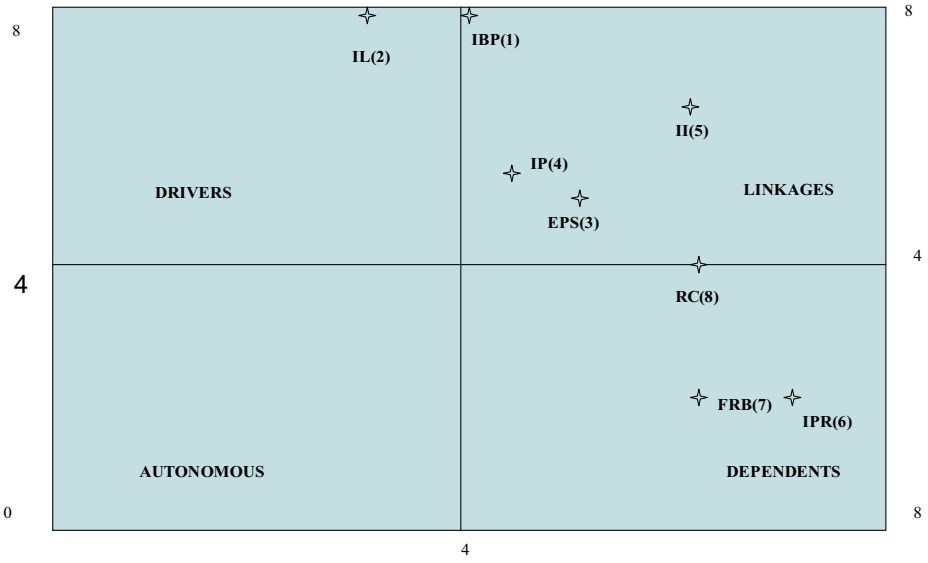

Figure 4.
ISM chart

Performance metric	2006	2007	2008	2009	2010
Rush orders (percentage of total orders)	21	15	12	9	4
Average purchase cycle time (days) per order	22	19	14	10	4
Percentage of imports out of total procurement	32	36	33	35	30
Average percentage of supplies delivered on schedule (service level)	90	95	95	98	99
Percentage of suppliers with 100 per cent lot acceptance	97	98	99	100	100
No. of times production line stopped due to lack of supplier parts	2	1	1	0	0
Average time to replace rejected lots (days)	15	11	10	9	7

Table XVII.
Performance metrics over past five years for ABC procurement process

periods, which is adequately addressed by the "Linkages". "Drivers" are important in the context of creating new knowledge to sustain competitive advantage over the competitors in the market.

Summarizing, outputs from this phase are the KMC measurement equation KMC = 0.265KB + 0.711ER + 0.166SU, actual KMC metric from survey (5.82) and ISM application on business process outcomes with respect to the procurement process in ABC.

Step 5: Review

The review stage involves introspection of the present capabilities, comparison with the past and plan for the future. The deficiencies identified are rectified by going back to the particular stage and reassessing the desired measures. It is through such feedback cycles involving the five stages that incremental improvements are made.

The final stage of the DIBAR methodology involves critical analysis of the assessments carried out in the earlier stages with respect to the KMC of the business process or organization. Monitoring of the KMC ratio (actual metric/target metric) is an important activity in this stage. In the study carried out, the KMC ratio is found to be (A/B) = (5.82/6.41) = 0.90, which augurs well for the procurement process in ABC. The perceived KMC of procurement function may be attributed to, among other factors, its unique culture over its long existence in the country, which is difficult for a new company to replicate.

Developing KMC by nurturing the factors mentioned is a long and tedious process. It is, therefore, essential to determine appropriate measures for short-term monitoring of the process under study. Metrics used for performance measurement in procurement function helps to compare the performances over a period and acts as a yardstick of achievement in a desired area. Performance metrics for procurement may include elements like per cent of supplies delivered on schedule, per cent of suppliers with 100 per cent lot acceptance for one year, purchase order cycle time, average time to replace rejected lots with good parts, number of items billed but not received, supplier parts scrapped due to engineering changes, number of times per year line is stopped due to lack of supplier parts, average time to fill emergency orders, per cent of defect-free supplier model parts and time required to process equipment purchase orders.

A list of performance metrics over the past five years (2006-2010) has been prepared for the procurement process in ABC and shown in Table XVII. It is observed that there has been a significant decrease in the rush or emergency orders over the past five years. The average purchase cycle time per order has also reduced drastically. This has been possible due to proactive measures taken by the management, one of which is issuance of smart cards with credit limits to senior executives for direct local purchases (within their authorized limits), saving on internal lead time. ABC relies on imports to a large extent (30:70 ratio) due to a large number of complex projects handled across the country. Although the procurement of imported materials from suppliers is not a problem, getting customs clearance at the domestic airport is a time-consuming process and results in unwanted delays. The service level of suppliers has been excellent and there has not been a major instance of the production line being affected due to lack of supplier parts.

An introspection into building the KMC of the procurement process in the future would lead us back to the KMC equation derived earlier KMC = 0.265KB + 0.711ER +

0.166SU. KMC is most sensitive to change in ER compared to KB and SU. It is obvious that the work procedures followed in procurement process leveraged through ICT form an important KMC in ABC, more so due to the centralized nature of procurement. The huge amount of explicit knowledge so accumulated also has as an important contribution to the build-up of KMC for the process. However, it would be interesting to compare ABC with leading KM exponents in the Indian market for better understanding of its capabilities.

Financial data over the years can be used to verify some of the business performance measures. The Tobin's q measure and market value/book value are good indicators of the intangible assets of a company, which is primarily its intellectual capital. This measure has been used indirectly as an indicator of KMC of the organization, although macro-economic indices affect the outcome to a large extent. Moreover, it is difficult to relate the outcomes directly to a business process. The financial indicators relevant to the study are provided in Table XVIII.

This stage has significant implications for the organization:

- Review of the organizational infrastructure needed to support knowledge capture, communication and sharing processes at all levels within the organization. It is desirable to have integrated systems providing suitable sharing platform to access knowledge from diverse internal and external sources with the organizational KMS. Flat and open organizational structures facilitate transparent knowledge flows and processes, with process owners providing clear directions and feedback processes.
- Identification of organizational knowledge that can be communicated and captured in writing (explicit) and verbally (tacit) by identifying key resource persons in critical areas of execution. Motivating and encouraging individual employees to purposefully capture, disseminate, transfer and apply existing or newly generated useful knowledge, especially tacit knowledge is important. Where there is invariance as to the degree of importance of a resource, there is more tacit knowledge present than when managers disagree.
- Explicit rewards such as promotion and implicit incentives such as recognition in organizational events to encourage employees to apply what they know or learn. Team-based rewards (promotion incentive and bonuses) and companywide incentives (profit sharing, salary incentive and employee stock options) would be

Key financial indicators	2006	2007		2008	2009	2010
PAT (INR in million)	786.3	446.0	616.6	800.4*	532.4	936.3
Market share (Per cent)	33.31	NA	32.59	32.83	30.26	35.07
Book value (31 December/31 March)	61.29	67.45	76.13	121.51	124.07	130.75
Market value(31 December/31 March)	170.55	129.95	203.05	131.65	175.80	341.00
Market value/book value	2.70	1.93	2.67	1.08	1.42	2.61
Tobin's q	0.36	0.5	0.37	0.9	0.7	0.4
RoCE	NA	NA	21.4	10.3	7.6	9.4
RoE	NA	NA	23.8	11.4	5.1	10.3

Notes: *Includes interest income of INR 242.69 million and exceptional income of INR 245.68 million mainly comprising sale of property and gains arising from a finance lease arrangement

Table XVIII. Key financial indicators of ABC related to intellectual capital

particularly instrumental in enhancing knowledge sharing within teams and across organizational units, respectively. In the case of knowledge sharing through informal interactions, the key enabling factor is trust between the individual and the organization. In this case, the procedural and distributive fairness of organizational rewards are important factors in the development of trust.

- Management awareness for knowledge protection at various organizational levels. The degree of organizational reliance on existing versus new knowledge resources can be ascertained over a period and the knowledge repository updated. Firm actions should be aimed at protecting the existing knowledge resources of the organization, both from a legal perspective and for future usage.

Results and discussion

The regression coefficients of the identified variates in Table XII are expectedly all positive, which means the factors positively contribute to KMC. As the scales are standardized, it is evident that the variate "embedded routines" has a significant impact on the KMC compared to other variates, viz., "knowledge base" and "shared utilization". The significance of "embedded routines" is due to the fact that explicit knowledge required for managing and controlling different business processes is derived from the ERP system of the company. The ERP is invoked for any transactional process in procurement and the "knowledge base" consisting of information repositories and databases serve as an important source of "processed data". The culture of the organization, which is a constituent of "shared utilization", mainly facilitates the free flow of knowledge across departments related to the procurement process. The ICT and structural factors comprising "embedded routines" enable ABC to deploy their own in-house team to handle maintenance-related issues instead of relying on third-party service providers. As procurement is centralized, the ERP is a vital tool for communicating with the business units across the country and, in some instances, with the suppliers. ABC, therefore, follows a codification-based strategy, predominantly ICT-based, facilitating knowledge reuse. Although a substantial part of ABC's knowledge is embedded in ERP routines, it often changes with the environmental context and time. The codification strategy allows for better knowledge searching and dissemination across functional and business units of ABC. For example, the "GANGES" initiative adopted by ABC recently aligns the financial accounting systems of 11 countries through a common template of chart of accounts in the SAP system, helping in generation of consolidated financial reports. Improved ICT infrastructure could lead to greater centralization and codification, which necessitates sharing of tacit knowledge. The "knowledge base" is a source of explicit and tacit knowledge cultivated over a long time and has considerable impact on the KMC. "Knowledge base" is an essential source of knowledge renewal and calls for expertise (tacit knowledge) to destroy old, irrelevant knowledge and create new, relevant ones. The rich information on entities like suppliers, products and processes, along with the ability to protect and retrieve the information when necessary, provides the context for creating new knowledge like developing supply sources, negotiating and writing contracts and developing alternate materials and sources. The importance of "shared utilization", so essential for building the

social-based KMC, is comparatively less, as built-in processes of ERP system minimize people-to-people interaction. This may be attributed to the failure of the management to clearly articulate the intention of KM initiatives in ABC. This also came out during informal discussion with some employees, who cited lack of time and absence of suitable forums to contribute their know-how to the organization.

The volume of information on products, processes, customers, suppliers and competitors over the years has helped ABC build up a huge repository of data, which can be processed to generate knowledge. The routines and best practices developed over the years are embedded within the organizational memory which can be accessed through an integrated real-time procurement module on a common ERP platform. However, ABC's over-reliance on the ERP system could inhibit knowledge discovery and innovation. There is a need to encourage social processes to facilitate tacit knowledge sharing between employees of ABC. Cross-departmental training programmes and workshops to improve technical knowledge should be further encouraged. Benchmarking the effectiveness of its KM initiatives post DIBAR *vis-à-vis* other competitors could be an important learning exercise for ABC. Procurement activities in ABC requiring application of tacit knowledge include first cost of purchase versus total cost of purchase, make or buy decisions, price negotiations and vendor development. It is important to identify individuals possessing such tacit knowledge in ABC for retention, as they are important sources for creation of organizational knowledge.

Despite ABC's emphasis on codification, it is evident that knowledge is often transmitted orally and implicitly between individuals spanning functional boundaries. ABC's knowledge, therefore, includes the specific "know-how" and "collective skills" of its employees that differentiates its capabilities *vis-à-vis* other organizations following similar strategy.

The KMC of ABC, considered as an asset, is validated through financial indicators related to intellectual capital shown in Table XVIII. Prior to 2007, ABC followed the accounting year as April-March. Since 2008, it is following the calendar year as the fiscal year. 2006-2007 was a threshold year for ABC, considering the change in management of the holding company. Since then, there has been an upward growth in terms of profits and market share, which are tangible in nature, as well as the market value/book value ratio, which is intangible in nature. Tobin's q ratio of 0.4 indicates the knowledge-based capabilities in ABC. The market share and profit after taxes have also increased considerably in 2010, indicating positive growth in business performance.

The empirical study conducted on a single organization limits the generalizability of the findings against the research questions. Hence, the validation of the assessment methodologies across a cross-section of industries is a possible area of future research. Future studies could include variables like industry analysis, nature of the organization, its life-cycle position, size and competitive intensity for gauging the KMC. A longitudinal study providing causal relationships of the capability levels with respect to the organizational performance in terms of measurable outcomes is desirable. In this regard, it would also be interesting to explore how organizations move across different levels, in different areas over a period. Moreover, comparing the contributions of past research summarized in Table I, the major contribution of this study has been to provide a simple, feedback-oriented, holistic and objective-based approach in determining KMC of an organization, which positively affects business performance.

Conclusions

Procurement managers and top management alike would like to have some reliable yardstick for the measurement of KMC in the procurement process. This empirical study in ABC is an effort to demystify the factors affecting KMC using the proposed DIBAR methodology.

The KMC ratio represents an objective to be attained; an index of performance that the department or process is coming close to the standards of performance or falling short of expectations in its contribution to the business performance as a whole. It must be recognized that the target metrics based on subjective judgement may or may not be accurate or realistic in its expectations. A record that is consistently above or below the stated target metric may show that the management is expecting too much or too little of its procurement process. The realization in itself is important; it may suggest and demonstrate that the KM processes should be modified to conform more closely to the actual performance. The KMC ratio provides a comparison of performance not only in relation to the stated standards, but also in relation to performance in previous periods. This ratio is important for the management to know for setting standards for the next review cycle. However, it is not a measure of comparison with procurement performance in other organizations or a definitive measure of excellence. There are too many variables involved to permit such general interpretation. Finally, the developed DIBAR model demonstrates the relationship between the knowledge outcome and the business performance of an organization, leading to the identification of the key KM attributes and drivers of the business. Milking these drivers develops competency in the department, leading to core competency in the long run.

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