

1 Introduction

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This book is about knowledge and knowledge management (KM) from a construction industry perspective. Its principal aims are to provide practitioners, academics, students and those interested in the construction industry with an improved awareness and understanding of KM principles and practice. It is also intended to provide guidance on the use of appropriate strategies, techniques and technologies for exploiting knowledge, for the benefits of the industry, projects and individual 'knowledge workers'.

Although knowledge is an age-old subject, one that occupied Plato and Aristotle and many other philosophers before them, the last two decades have witnessed an explosive growth in discussions about knowledge – knowledge work, knowledge management, knowledge-intensive organisations and the knowledge economy – albeit mainly in a non-construction industry context. The main impetus for the growth in KM in the last two decades includes globalisation and increased competition, diffusion of new information and communication technologies, financial implications of intellectual property rights, newer procurement routes, new work patterns, employment rights and contracts, and also contradictory political and ethical underpinnings. An important aspect of this book, therefore, is to explain this new emphasis on an enduring subject.

This book brings together work from key, selected contributors that offers insights, raises awareness and provides advice on managing knowledge. The contributors adopt varying forms of critical and reflective approaches on the knowledge discussions, informed by their empirical, theoretical and practical experiences on the subject.

In Chapter 2, we are reminded that the concept of KM is not new, that it has been with us for many centuries. However, the chapter presents a strong case for the prominence and rise of KM in recent decades. The chapter also succinctly presents the nature of knowledge dimensions, including the distinctions between tacit and explicit knowledge. It truly expounds on the complexities of knowledge, its social dimensions, its 'stickiness' and its context specificity. An appreciation of knowledge sharing across organisational boundaries and the importance of absorptive capacity when reflecting on how to learn from external sources are documented. An understanding of the complexities of knowledge allows us to understand the challenges in requisite processes needed for managing it in dynamic and complex situations.

2 Knowledge Management in Construction

In Chapter 3, a case is made for managing knowledge in a project-based environment. The construction industry, like many project-based industries, has its own peculiarities which impact upon KM. These include having to work in projects with start and finish dates, where 'short-termism' is rife, where different professionals and workers are brought together for a relatively short period and then disperse. Construction workers on site, in the main, are contracted on a short-term basis and live a more-or-less nomadic way of life, moving from one project to another. Harnessing and consolidating certain aspects of knowledge assets for organisational use is difficult in these situations. In many ways, the construction industry is still seen as a 'traditional' industry. However, things are changing. The construction industry is also, more often than not, easily associated with its tangible products such as buildings, roads and other structures. Viewing the industry as a 'service' provider often seems to take a back seat. Yet, the industry is made up of different professionals and tradesmen and -women who offer their services and knowledge in the work they do. This chapter informs us that given the nature of construction markets today, the greater demands from clients, the increasing level of awareness of clients, the complexities of projects in terms of size, cost, technology and the increasing nature of collaborative forms by which clients procure construction works, the construction industry is increasingly becoming a more knowledge-intensive industry. A case is made for the need to value knowledge workers in the construction industry, as these are the people who provide important skills and knowledge in the provision of services for the industry in what is a knowledge economy.

Chapter 4 considers two very important aspects of the KM debate. First, it considers the strategies for KM in the context of the construction industry. In doing this, it cleverly addresses what KM means to construction. Second, the chapter addresses the important issue of the need for, and the challenges of, a business case for KM.

The chapter argues that for construction organisations, good KM practice requires knowledgeable people who are supported by integrated information and data sources in order to generate informed decision making. It also presents some KM strategies that have been found to be successful within construction organisations. Readers would benefit from the examples of successful strategies drawn from organisations such as Arup, Taylor Woodrow, Thames Water and Mott McDonald. It is noted that organisations could seek to capture construction knowledge in documents, databases or intranets. This 'explicit' knowledge approach often works well for standardised problems, but does little to enable the exchange of new ideas. Alternatively, organisations could focus primarily on people in order to develop ways in which they can exchange their 'tacit' knowledge to facilitate innovation. This approach, however, allows excessive duplication and wheel reinvention in some cases. It is argued that an appropriate balance of 'explicit' versus 'tacit' approaches depends on each organisation's strategy

and the particular case in point. An organisation is bound to require elements of both approaches, and must integrate the two effectively.

Attention is also given to the role of people, processes, culture and technology as important embodiments of a robust strategy for KM. For example, we are informed that having an open and participative culture which values the skills and contributions of employees at all levels is critical to a successful KM initiative. In terms of successful processes in larger organisations, the chapter suggests embedding good KM practices into normal organisational processes to help transfer knowledge across the business. Creating a network of virtual knowledge leaders is useful in cascading good KM practices. Developing a network of divisional knowledge activists to help 'spread the word' is equally useful. It is also beneficial to align KM with quality assurance (QA) following the ISO 2000 approach such that KM can become embedded in the organisation. For a project-based industry such as construction, the chapter argues that project learning is complementary to an overall KM strategy. Post-project (or after action) reviews and learning histories are two important aspects of project learning.

Although much is said and written about different aspects of KM, not as much it seems is discussed about making a case for KM. The point, however, is made that since KM can represent a significant investment for an organisation, it is reasonable to apply it to business areas that will yield the best and most value.

We are informed in this chapter that a business case should be seen as a critical component of the KM initiative. The business case can be used to communicate the KM initiative to others, to establish a method for performance measurement and for receiving funding approval for the initiative. A good business case should be able to help answer some key questions often posed during the early stages of deciding to set up a KM initiative or project. Such questions include: Why is the organisation or unit embarking on the KM initiative? What is the initiative about? What is the likely cost of the initiative? What are the likely benefits or return on investment? How will overall success and failure of the initiative be measured?

This chapter also reflects on the 'value of knowledge'. In doing so, we are informed of the notion of assessing and quantifying the impact of knowledge initiatives or projects through such 'soft' approaches as communities of practice, quality circles and story telling. Similarly, issues associated with making a business case for KM, which considers quantifying intangible assets, are addressed.

Chapter 5 reflects on organisational readiness for KM. The premise on which this chapter is based and the message it attempts to present can be best summed up in the following words: 'If you would plant roses in the desert, first make sure the ground is wet'. This chapter introduces an important concept, which is *knowledge lifecycle management* (KLM). The point of this is that organisational knowledge could be said to have a lifecycle; it is discovered, captured, utilised and, eventually, retired (or lost) rather

than killed. It is argued that if one views organisations as 'knowledge engines' providing value to customers, then the processes of KLM are vital for organisational survival. This line of enquiry helps us to comprehend organisations as acquiring and using capabilities in the form of knowledge and skills in knowledge-intensive processes to deliver value-for-money products. In addition, the consideration of organisations as 'knowledge engines' helps, in part, to explain the need to focus attention on the prime, essential assets of the organisations; on strategic considerations; and understanding that the organisation's knowledge rather than its physical assets primarily differentiates it from its competitors.

Preparing the organisational context for KLM is all-encompassing. It has human, organisational and technological dimensions. In addition, there are strategic and tactical issues to be considered. The chapter informs us that as part of this, organisational design needs to reflect the firm's role in its supply chain. Knowledge workers (people) must be empowered and resourced to execute organisational activities. Other issues highlighted in the chapter as being important as part of organisational readiness for KM include the importance of building trust through leadership, identifying and populating 'knowledge evangelist roles', establishing 'ownership' policies for knowledge, identifying and implementing workable security policies, creating generic processes and procedures, providing robust technical infrastructure, establishing review procedures to ensure discussion of knowledge capture, the reviewing of reward policies and establishing personal performance measures for knowledge sharing.

Since organisations rarely take time to evaluate whether they are in fact in a position to implement policies and procedures to manage knowledge, the views and discussions presented in this chapter should be useful for organisations contemplating to do just that. Finally, the chapter reminds us that preparing an organisation for KLM is an interactive learning process which has positive and negative feedback loops, allowing for lessons and changes to be made during the process.

In Chapter 6, we are introduced to the different tools and techniques available for KM. The point, however, is made that the term 'knowledge management tools' should not be narrowly defined to mean just information technology (IT) tools. They also include non-IT tools required to support the sub-processes of KM. The chapter carefully distinguishes IT tools for knowledge management (KM technologies) and non-IT tools for knowledge management (KM techniques). A comparison between the two, together with examples, are provided in the chapter.

Organisations seem to encounter difficulties in identifying appropriate tools due to the range of competing products in the marketplace, overlap between the functions of various tools and the cost associated with acquiring and using them. The chapter examines existing approaches for selecting KM tools, discusses their limitations and goes on to present a new and innovative method as an alternative (SeLEKT – Searching and Locating Effective

Knowledge Tools). The method facilitates the selection of appropriate tools based on key dimensions of knowledge that reflect an organisation's business needs and context. It also considers, *inter alia*, whether the knowledge is internal or external to the organisation; 'ownership forms' reflecting whether knowledge is owned by individuals or shared; and the 'conversion types' reflecting the interaction between tacit and explicit knowledge.

This chapter also presents a comprehensive list of KM technologies and software applications classified by KM sub-processes and by KM 'technology families'.

In Chapter 7, we are introduced to cross-project KM. The central messages centre on the nature and characteristics of projects, the project environment (the context in which a project is initiated, implemented and realised) and how these impact upon how knowledge is managed in project-based environments such as construction. The chapter commences with a definition of a project, which is important in beginning to understand some of the subtle and fundamental differences between managing knowledge in a project-based environment as opposed to a non-project-based environment. Projects are temporary endeavours with start and finish dates, involve stated objectives and goals to be achieved, have resources that need to be expended, involve a set of interrelated activities, can often be one-offs (unique) and/or involve some elements of change.

The chapter makes the case that the changing nature of project organisations, for example, has implications on KM requirements across the lifecycle of a project. In this regard, we are reminded that each project lifecycle is made up of different activities carried out by different professionals and tradespeople, each having and also requiring different knowledge assets. The chapter also discusses the important issue of knowledge transfer across different projects, its dimensions in terms of the role of individuals, project reviews, contractual and organisational arrangements and the goal of knowledge transfer. This draws out the important issues of absorptive capacity of knowledge and how individuals and organisations learn, and how individuals in a supply chain are motivated to share and transfer knowledge. The concept of the 'knowledge dilemma' is brought to the fore. What knowledge should be shared and what knowledge should not in order to preserve the competitive advantage of an organisation. Similarly, it raises the issue of how knowledge transforms across the supply chains and the role of knowledge networks.

Another important contribution of this chapter focuses on the approaches for live capture and reuse of project knowledge, distinguishing between 'soft' concepts and 'hard' technologies. Soft concepts include collaborative learning and learning histories, whereas hard technologies include information and communication technologies such as project extranets, workflow management tools and other groupware applications for collaborative working. A conceptual framework for the live capture and reuse of project knowledge is described as a way forward for successful cross-project KM in

the construction industry. This reflects a step change in the way construction project knowledge is managed. Project knowledge files, an integrated workflow system and a project knowledge manager are important dimensions in the armoury needed to improve real-time knowledge capture.

Chapter 8 considers the role of KM as a driver for innovation. It argues that knowledge is highly associated with innovation. An organisation's capacity to innovate, it is suggested, depends to a very considerable extent upon the knowledge and expertise possessed by its staff.

The chapter also discusses the intrinsic and complex relationships between KM and innovation and the role of building and maintaining capabilities to facilitate the process. Since the innovation strategies of an organisation are constrained by their current position, and by specific opportunities open to them in the future based on their competencies, construction organisations would need to determine their 'technological trajectories or paths'. This will involve taking due cognisance of the strategic alternatives available to them (e.g. organisational processes), their attractiveness, and opportunities and threats that lie ahead. The organisational processes adopted to integrate the transfer of knowledge and information across functional and divisional boundaries (strategic learning) are essential and need to be managed. It is equally argued that organisational core capabilities and core competencies, which are difficult to imitate or copy and which provide competitive advantage for innovation, are developed through a knowledge building process. The knowledge building process includes problem solving, future experimenting and prototyping, internal implementing and integrating and external importing of knowledge. Also, an important capability is the expertise to manage internal and organisational complementary resources.

The chapter provides examples on how, through mobilising knowledge, experiences and technological skills, organisations can improve their ability to innovate: by focusing on a particular market niche, through novelty, through complexity, by stretching basic models of products and processes over a period of time, by continuous movement of the cost and performance frontiers, and by integrating personnel and the team around products and services.

Issues of strategy, process, structure, culture and technology and their impact on KM are also discussed. The implications for managers in managing knowledge for successful exploitation are discussed. It is suggested that managers have critical roles to play in making knowledge productive, in knowledge development and in the exploitation of knowledge for innovative performance. Specific ways of involving managers and deepening a manager's understanding of KM issues are also documented in the chapter.

In Chapter 9, attention is focused on performance measurement for KM initiatives and projects. We are reminded in this chapter that the most compelling argument for measuring the performance of knowledge assets and KM is to demonstrate its business benefits so that resources and support

necessary for a successful implementation can be provided. It confirms that the old maxim 'you cannot manage what you cannot measure' also applies to KM. The chapter also presents examples of cost savings from KM programmes from some selected companies.

In considering types of performance measures, we are informed of two distinct aspects of KM that need to be measured. The first relates to knowledge assets (stocks) and the second to KM projects or initiatives (flow). Measures for knowledge assets seem to relate to what organisations know, and what they need to know or learn in order to improve performance. Measures of knowledge assets or stocks or intellectual capital focus on several components, including human, structural and customer capital. On the other hand, measures for KM projects or initiatives focus on the expected outputs of KM interventions. Cost-benefit, cost-utility and cost-effectiveness measures are often used in this regard.

The chapter also presents and makes a comparative assessment of the different performance measures for KM. These measures include the metric approach, economic approach and the market value approach. Other application tools such as business performance measurement models, Skandia Navigator, Intangible Asset Monitor, Human Resource Accounting, IMPaKT Assessor, KM Benefits Tree, Degussa–Huls Approach, Inclusive Value Methodology, market-to-book-value ratios, Tobin's q ratio and the Intellectual Capital Index are also discussed.

There are simple and complex performance measures. As organisations 'progress' to a stage where implementation of KM is mature and well coordinated, a more robust measure may be required.

In Chapter 10, the discussions centre on KM strategy development. Building on Chapter 4, which introduced the important issue of strategy, the chapter explores the concepts of 'supply-driven' and 'demand-driven' KM strategies, as well as 'mechanistic' and 'organic' KM strategies. While supply-driven KM initiatives assume that the fundamental problem of KM is to do with the flow of knowledge and information within organisations, the demand-driven approaches are more concerned with users' perspectives and their motivation and attitude. KM strategies can also be described as 'mechanistic' or 'organic' with respect to the emphasis on either 'explicit knowledge' (mechanistic) or 'tacit knowledge' (organic). Mechanistic approaches often rely on IT as compared to organic approaches (which focus on non-IT tools). In this chapter, we are also reminded of the importance of 'content' (the knowledge that is to be managed) and 'context' (organisational setting for the application of knowledge) in the success of KM strategies.

The chapter also addresses the 'how' of KM in relation to the development of KM strategies within construction organisations by presenting and discussing a CLEVER (Cross-sectoral LEarning in Virtual EnteRprise) approach to KM. The CLEVER approach, which is linked to business drivers and goals, concentrates mainly on organisational and contextual aspects of

KM strategy in dealing with the 'definition' and 'analysis' of a knowledge problem in order to facilitate the selection of an appropriate strategy for KM in construction organisations.

Chapter 11 addresses the concept of corporate memory, focusing on design knowledge capture, sharing and reuse. Corporate memory is defined as a 'repository of knowledge in context'. Put simply, it is an 'external' knowledge repository containing the organisation's past projects that attempts to emulate the characteristics of an internal memory, i.e. rich, detailed and contextual. Corporate memory grows as the design firm works on more projects. In this chapter, we are also informed that the main reasons why knowledge reuse often fails, are that it is not captured, it is captured out of context, rendering it not reusable, or there are no formal mechanisms for finding and retrieving reusable knowledge. It also notes that reusing designs and design knowledge from an external repository of knowledge from previous projects fails due to the fact that state-of-practice archiving systems do not support the designer in finding reusable items and understanding these items in context in order to be able to reuse them. The chapter raises and attempts to answer very searching questions such as: What is the nature of knowledge capture, sharing and reuse? What are the key characteristics of the knowledge reuse process? How can the design knowledge reuse process in the architecture, engineering and construction (AEC) industry be supported by a computer system, and what are the natural idioms and interaction metaphors that can be modelled into a computer system to provide an effective knowledge reuse experience to a designer? The chapter presents and discusses innovative capture and interaction metaphors and their software implementation which act as a repository of knowledge in context. The presented prototype systems support knowledge capture, sharing, finding, reuse through project context exploration, and evolution history exploration in a large corporate memory that is made up of informal tacit and formal explicit knowledge.

In Chapter 12, attention is given to the building of a knowledge-sharing culture in construction project teams. Knowledge sharing, we are informed, relies on reaching a shared understanding of the underlying knowledge, in terms of not only 'content' but also the 'context' of knowledge. The chapter presents and discusses some findings from an industrial case study of knowledge sharing involving construction professionals and the client's specialist consultants. The importance of socialising, sharing positive as well as negative experiences, and knowledge 'shielding' to protect a client from its competitors are explored. Communication is seen as key in knowledge sharing. Competition appears to negatively influence knowledge sharing. It is also suggested that factors such as openness, motivation, trust and pressure of time impact upon knowledge sharing in complex ways.

This book concludes with a succinct recap of the main issues drawn from all the chapters. The implications of the issues raised in the various chapters for organisations, practitioners and for academia are also presented.

Managing knowledge effectively has the potential to provide substantial benefits to organisations, projects and individual workers. However, it is not easy. Having said that, there are certain steps to take to begin to put things in place, address challenges along the way and exploit potential benefits. These are the steps that the contributors to this book have attempted to provide. These steps need to take account of people, technology, structures, process, strategy, finance and the consideration of environmental, legislative and market conditions. KM should be seen as a continuous and long-term endeavour. It should also be seen as an asset and not a liability. That is the collective message of this book. If the book helps individuals and organisations in construction and other project-based industries, even in a very small way, towards improving their understanding of KM, then the primary aim of the book would have been realised.