

Article

Communities of Practice Approach for Knowledge Management Systems

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Abstract: In this digital world, organisations are facing global competition as well as manpower pressures leading towards the knowledge economy, which heavily impacts on their local and international businesses. The trend is to foster collaboration and knowledge sharing to cope with these problems. With the advancement of technologies and social engineering that can connect people in the virtual world across time and distance, several organisations are embarking on knowledge management (KM) systems, implementing a community of practice (CoP) approach. However, virtual communities are relatively new paradigms, and there are several challenges to their successful implementation from an organisation's point of interest. There is lack of CoP implementation framework that can cater to today's dynamic business and sustainability requirements. To fill the gap in literature, this paper develops a practical framework for a CoP implementation with a view to align KM strategy with business strategy of an organization. It explores the different steps of building, sharing, and using tacit and explicit knowledge in CoPs by applying the Wiig KM cycle. It proposes a practical CoP implementation framework that adopts the Benefits, Tools, Organisation, People and Process (BTOPP) model in addressing the key questions surrounding each of the BTOPP elements with a structured approach. Finally, it identifies key challenges such as organizational culture and performance measurements, and provides practical recommendations to overcome them for a successful CoP implementation.

Keywords: knowledge management (KM); communities of practice (CoP); tacit knowledge; knowledge sharing; KM cycle; CoP framework; organizational culture; performance measurement

1. Introduction

With the recent trends in globalization and new developments in the field of information and communication technology (ICT), knowledge has been identified as one of the most critical resources that contributes to the competitive advantage of an organization [1–3]. McElroy describes the management of knowledge to be closely connected to innovation management and organizational learning [4]. Knowledge management (KM), an emerging discipline, is aimed to facilitate people to transform their way of thinking and to arrive at KM initiatives that could contribute to the governance of exploratory and exploitative learning for organisations [5]. Hence, KM projects could encourage exploitative learning to increase efficiency, and exploratory learning to stimulate innovation for sustainability of organisations in this increasingly competitive environment [6]. In general, KM projects are focused either towards providing technology with ICT-based innovative KM initiatives, or towards governing human processes with social practice-based KM initiatives for organizational learning and the management of knowledge [7,8]. From Wiig's work, "historically knowledge has always been

managed, at least implicitly” [9]. Therefore, KM has not been popular until the past decade with the new paradigm shift in transmitting and managing organizational knowledge [10–12].

In recent years, many research studies have put forth the case for KM with the rapid advancements in innovative technology solutions [13,14]. However, technologies being easily imitable, the competitive differentiating factor still lies in the uniqueness of each organisational knowledge by virtue of its tacitness and immobility [15,16]. The organisational knowledge buried in the human capital of an organization is recognized as its prime economic asset. Organisational learning, which is the process of creating, retaining, and transferring knowledge within an organization will facilitate individual learning as well as group/team learning, wherever possible [17,18]. In reality, such theoretical arguments for applying KM have failed to relate to actual experience of businesses when it comes to practical implementation [19,20]. In today’s digital and competitive world, the absence of a practical framework for managing an organizational knowledge forms the key motivation for this research work. This paper explores the Communities of Practice (CoP) approach with a mixed model of combining ICT-based KM initiatives with social practice-based KM initiatives for implementing KM systems (KMS) successfully. The purpose of the paper is to propose a generic CoP implementation framework by mapping the popular Wenger CoP model with Wiig KM cycle. To the best of our knowledge this is the first of its kind with an attempt to fill the gap in literature. The proposed framework aims to provide a practical guideline stepping through the KM cycle and the Benefits, Tools, Organisation, People and Process (BTOPP) model for CoP implementation as an effective and sustainable KMS development. Every new proposal should critically consider the challenges for implementation. Our research proposal also identifies such implementation challenges and recommends ICT-based practical measures to overcome them with the focus of aligning the organization’s KM strategy with its business operations. These form the main theoretical contributions of this research.

The rest of the paper is organized as follows. In Section 2, we explain the background concepts of knowledge, KM, and CoP in literature and identify the need for this research. In Section 3, we propose a practical framework for adopting CoP approach for KMS implementation. Then, we describe in detail the key steps of the framework with suitable illustrations in Section 4. Finally, in Section 5, we provide conclusions and future research directions.

2. Research Background

2.1. Methodology

This research adopts the Grounded Theory research methodology due to its extensive use found in literature to investigate ICT development and practices. The purpose of this research is to examine how the social practice-based KM initiative such as CoP could be combined with ICT-based KM initiatives for implementing KM systems successfully. In particular, the aim of our research is to explore the best CoP model to fit with the most appropriate KM cycle to propose a CoP implementation framework as a KM strategy of an organization. The framework is to provide a set of steps as a guideline that helps to follow through the various stages of effective management of knowledge in an organisation. Before proceeding with this research task, we performed a literature survey for any existing publications that might have already attempted our research purpose. We found that existing studies that were close to this research merely adopted CoP to specific organisations, such as online collaborative learning in higher education or CoP for the health industry, that are specific to certain industries [13,20]. None of them provided a generic framework that could be adopted by any industry. Hence, the overarching questions that guided this research were as follows:

1. Which KM cycle can be best related to the most popular CoP model?
2. How can the steps in the KM cycle be practically adopted for CoP implementation?
3. What is the proposed CoP implementation framework?
4. What are the CoP implementation challenges and ICT-based solutions to address them?

By answering the above questions, this research aims to develop CoP and ICT-based KM theories and concepts that can be generalised into a practical implementation framework. To achieve this, we first explore the underlying concepts of KM and CoP.

2.2. What Is Knowledge Management?

KM is perceived differently in literature by different researchers and practitioners based on the focus portrayed in its description [21–23]. KM is the explicit control and management of knowledge within an organization aimed at achieving the company's objectives—van der Spek. Knowledge Management can be considered as the way organisations build, supplement, and organise knowledge routines. According to Larry Prusak of McKinsey Consulting, “It is the attempt to recognize what is essentially a human asset buried in the minds of individuals, and leverage it into an organisational asset that can be accessed and used by a broader set of individuals on whose decision the firm depends”. Knowledge management relates to activities such as learning and innovation, benchmarking and best practice, strategy, culture, and performance measurement [24,25]. More recently, it is widely accepted that KM is concerned with the generation, capture, storage, and sharing of knowledge with an intent to take timely action for increasing an organisation's competitive advantage.

2.3. Explicit and Tacit Knowledge

Knowledge is considered as the prime source of competitive dominance in an organisation and it exists in both tacit and explicit forms. Explicit knowledge is information that is searchable and can easily be found in books, documents, software, hardware, and other instruments including the Internet [26]. It can be recorded and expressed in a number of ways such as text, numbers, codes, or mathematical formulas. Examples of this type of knowledge include security policy document of an organization, formal customer complaints or suggestions, and so on. While transferring explicit knowledge to others is easy, safeguarding it from unauthorized use is more difficult. On the other hand, tacit knowledge is deeply rooted with knowledge that is in the human mind from the experience gained through the jobs done or knowledge gained through opinion communicated by experts/management about market trends or decision strategies, and so on. The embodied expertise that exists in tacit form is the most valuable asset to organisations as it could be difficult for competitors to imitate. However, it is a complex task to transform tacit knowledge into tangible forms such as a written document or in digital storage form [27,28]. Tacit knowledge is more commonly transmitted to others verbally in the form of stories, coaching, or apprenticeship [29].

Current management paradigms are not capable of managing intangible/tacit knowledge as compared to tangible/explicit knowledge, which can be easily communicated among employees and stored digitally in an organization [30]. With the volatility of workforce, employees changing their jobs typically take all their knowledge with them. In addition, knowledge hoarding with employees gathering and guarding this knowledge for personal use can have a silo effect on the organisation. This is why employees need to understand the purpose of knowledge sharing within the organization for competitive advantage and develop sufficient motivation to willingly participate in KM initiatives. It is very difficult to promote sharing of tacit knowledge with others as it is highly personal and tough to formalize [31,32]. While face-to-face interaction facilitates of knowledge sharing, it could be time consuming. However, both explicit and implicit knowledge need to be secured and safeguarded within the boundaries that are clearly earmarked for knowledge sharing. Good knowledge sharing strategies could lead to employee satisfaction and motivation, as well as greater business improvements. There is a need for a structured approach to facilitate knowledge sharing and benchmark the implementation efforts. With a view to addressing these challenges, this paper explores CoP strategies for practically incorporating knowledge sharing techniques that would result in successful KMS implementations.

2.4. The Need to Revisit Community of Practice

The term community of practice (CoP) was initially introduced in the seminal work of Lave and Wenger [33,34]. They refer CoP to groups of individuals who share a craft or profession and engage in the sustained pursuit of a shared enterprise. In other words, CoPs are formed by people who engage in a process of collective learning in a shared domain of human endeavor. Wenger defines CoP as groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly. In this definition, learning can be the reason the community comes together or an incidental outcome of member's interactions in the community. However, in Wenger CoP model [34], three characteristics form crucial components:

- (i) the domain (shared competence),
- (ii) the community (engaged members), and
- (iii) the practice (shared repertoire).

Wenger establishes a relationship between CoP and KM strategy by arguing that these three elements provide the key structures to support learning, sharing, and stewarding knowledge. CoPs have long existed in various forms where people with a common passion, a concern or a set of problems regarding a particular topic interact regularly with an intention to deepen their knowledge and expertise [35]. In CoP, individuals with related interests interact with respect to situated learning in the workplace as well as with other communities in a more informal manner [36]. The use of CoPs as a formal strategy for knowledge management is relatively recent and calls for much innovation and research. Even though many different conceptions of social learning approaches to CoP theoretical framework are reported in literature, one of the most widely cited and influential model is by Wenger [31]. Hence, we propose to adopt Wenger CoP model in this research even though it does not directly relate its three components to all the KM processes, such as the synthesis, modelling, and organization of knowledge in an organization. Hence, there is a need to adapt Wenger CoP model to combine its essential three elements of domain, community, and practice in a formal manner for implementing CoP as a successful KM strategy in organizations.

The 21st century is witnessing the emergence of a new global knowledge-based economy as knowledge is becoming increasingly diverse, sophisticated, and distributed. Businesses are going global with the developments in ICT and these have significantly increased the ability to create and share knowledge worldwide [37,38]. There has been an explosion in mobile and telecommunication technologies in the past decade with a trend towards flexible working environments, where employees work outside the physical office locations from anywhere and anytime [39,40]. In addition, with the recent evolution of Internet of Things and Big Data in the digital world, organisations are required to innovate in order to survive in this new paradigm shift. Specifically, they must look to new sources of competitive advantage and engage in new forms of competition, and knowledge is considered as the key source of competitive advantage for organisations to succeed in this knowledge economy [41,42]. An organisation's resources and manpower capabilities influence the strategic decision making to stay competitive. This human capital, that can innovate and renew knowledge, has the potential to create value for the future of the organization and forms the foundation for revisiting and renewing the development of communities of practice [43,44].

In the past, only large organisations have predominantly adopted CoPs as a major element of their KM strategy [12,45]. World Bank, an international financial institution involved in global partnership for fighting poverty worldwide, has successfully used CoPs as a sustainable solution. They have successfully tapped into the vast knowledge that already exists within the organisation, rather than trying to discover new knowledge [46,47]. Similarly, some of the leading multinational companies such as IBM have been supporting and acknowledging their CoPs for their success [48]. In healthcare, it is more common to create CoPs to facilitate sharing of knowledge and learning among healthcare professionals to improve medical practice [49,50]. However, with the proliferation and advancement of Internet, CoPs can be adopted by any firm irrespective of their size and type of

industry. Importantly, future CoPs are required to adopt different strategies for KM as they have the ability to operate anywhere and anytime with no physical or geographical barriers. In order to reap the full benefits of these CoPs that exist virtual over the Internet, they need to be properly understood, deployed, and supported. CoPs cannot be conceived and supported in the same way as other organisational initiatives as they lack formal structure, standardized protocols, and performance measurements. Organisations have to create conducive environments for employees to voluntarily participate and include other members of the community in their pursuit for knowledge sharing and organizational learning.

To summarise, in today's digital world, all organisations, small, medium, and large, are entering into both local and global competition that require them to work in disparate groups or teams and collaborate productively. Inter-organisation and stakeholder communication has become increasingly important. CoP provides the right concept to create new models and initiatives for connecting people, sharing knowledge, and fostering individual as well as group learning and development. In an attempt to provide a framework for a successful CoP model, this paper provides a guideline by following through a typical set of KM cycle steps with a focus of adopting the best practices as an illustration.

3. KM Cycle and CoP Implementation Framework

Knowledge management involves a continuous cycle of three main processes, namely knowledge creation, knowledge distribution, and knowledge application. A KM cycle follows through various stages of transforming information into knowledge within an organization. There are four commonly adopted models of KM cycle: Wiig (1993), Zack (1996), Bukowitz and Williams (2000), and McElroy (2003) [21]. While all the four models of KM cycle cover the core processes of transforming information into knowledge, each model differs in its emphasis with respect to managing an organization's intellectual assets. While the Zack KM cycle considers knowledge refinement to be crucial, the Bukowitz and Williams KM cycle gives more emphasis to learning and knowledge contribution aspects. The McElroy KM cycle gives importance to knowledge validation by identifying knowledge content that is of value to the organization. Lastly, the Wiig KM cycle identifies reconstructing, modelling and organizing knowledge to be important. This emphasis is given to facilitate the creation, accumulation, deployment, and use of quality knowledge for 'intelligent-acting' by individuals as well as organizations. This forms the key motivation to adopt Wiig KM cycle for CoP implementation in today's context as it aligns an organisation's KM strategy with business intelligence for achieving competitive advantage and sustainability. Hence, in our proposed CoP implementation framework, we adopt the Wiig KM cycle.

According to Karl Wiig, for knowledge to be useful and valuable, it must be first organized. Further, it should be organized differently depending on what the knowledge will be used for with useful properties such as completeness, connectedness, congruency, as well as perspective and purpose [9,21]. Wiig identifies three requirements for an organization to conduct its business successfully: (i) business (products/services) and customers; (ii) resources (people, capital, and facilities); and (iii) ability to act. While the first two are quite commonly met by organisations, the distinguishing factor is their ability to act intelligently. The principal driving force for this to happen is by acquiring the knowledge to do things better. To reiterate, in the Wiig KM cycle, the major purpose of KM as an effort is "to make the enterprise intelligent-acting by facilitating the creation, cumulation, deployment, and use of quality knowledge". The emphasis here is to work smarter by acquiring relevant and high-quality knowledge that can be applied in a number of different ways. Hence, it can be adopted effectively to acquire quality knowledge through CoPs. Further, we map the three elements of the Wenger CoP model with the three conditions of the Wiig KM cycle for business success as follows:

- An organisation should have a business (products/services) and customers—this relates to the 'domain' element in the Wenger CoP model. The shared domain of interest and competence will be related to the products and services of the organisation's business and its customers

- An organisation should have resources (people, capital, and facilities)—this relates to the ‘community’ element in the Wenger CoP model. The members of the community refer to the people of the organisation with the support of capital and facilities for engaging in CoP.
- An organisation should have the ability to act—this relates to the ‘practice’ element in Wenger CoP model. The CoP can develop shared repertoire of their practice based on the practitioners’ capabilities and engaging actions.

For the CoP implementation framework proposed in this section, we adopt the Wiig KM cycle as it steps through how to build, hold, pool, and use knowledge for both individuals as well as organizations in a sequentially structured approach. Further, it fills the gap in the Wenger CoP model that does not directly relate to the KM processes of synthesizing, modelling, and organizing knowledge through CoPs, which are the additional key strengths of the Wiig KM cycle. We present the four major steps in the Wiig KM cycle for CoP implementation in Figure 1.

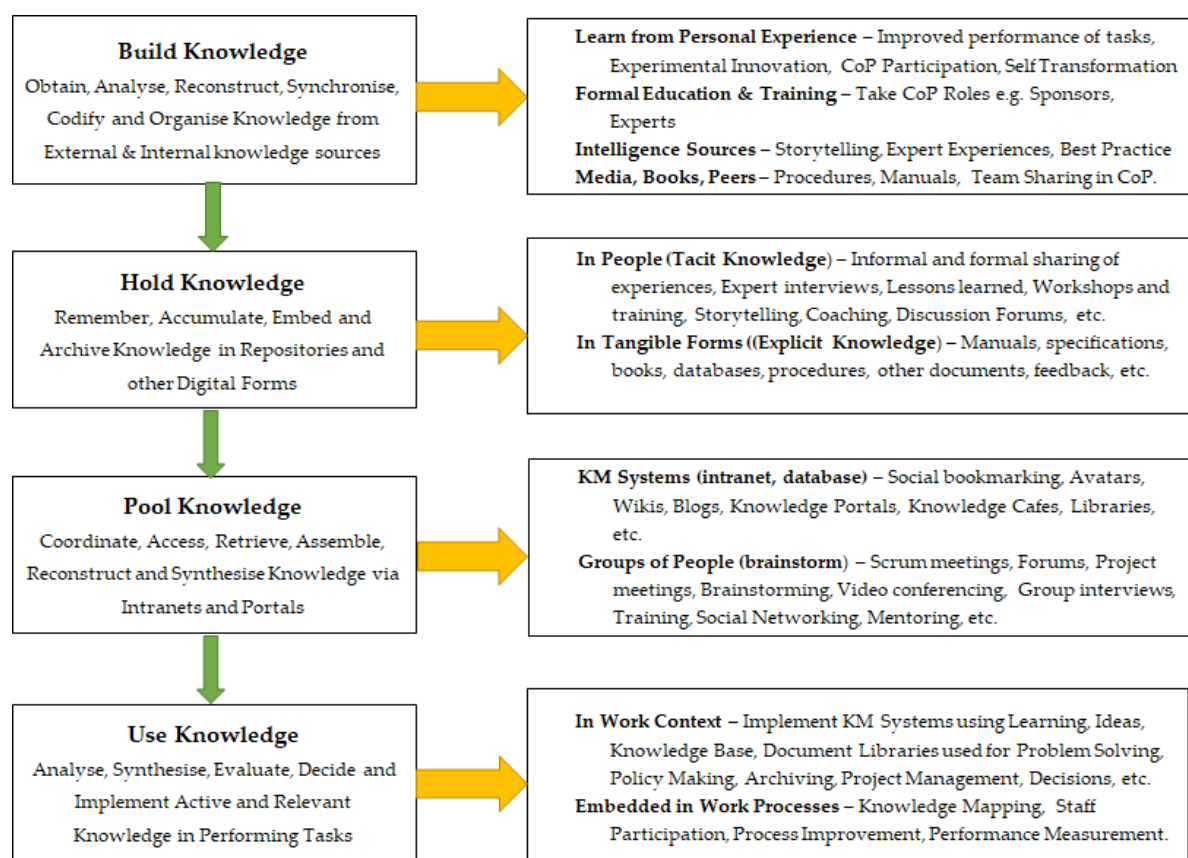


Figure 1. Community of practice (CoP) implementation using the Wiig knowledge management (KM) cycle.

The CoP implementation by adopting the four steps of The Wiig KM cycle is described below:

Step 1: Build Knowledge

This step involves obtaining knowledge from internal as well external sources. New knowledge can be obtained in the following modes:

- (i) Learning from personal experience—when individuals improve in performing their tasks or innovate through experimentation or derive learning by reason of existing knowledge, and so on. According to the social theory of learning, the process of learning does not happen in isolation, rather it takes place from social participation [34]. Learning is associated with (a) Meaning

or Sense making (maps to domain element of Wenger CoP model)—when people discuss their life experiences in relation to the organisation's business; (b) Practice (maps to practice element of Wenger CoP model)—when individuals talk about the activities and the how they are done; (c) Community (maps to community element of Wenger CoP model)—when someone is recognized to be competent through participation; and (d) Identity—when individuals change and get transformed. Hence, CoPs, where these forms of learning are embedded, can facilitate organisational learning, which is key to building knowledge.

- (ii) Formal education and training—this mode of gaining knowledge through formal and intense coaching with goal setting and specialised training facilitates experts from a knowledge domain to participate in CoP taking various roles [35,51,52]. This maps to the domain element of Wenger CoP model.
- (iii) CoP includes typical defined roles such as (1) Sponsors—champions of the CoP, resource brokers, advisors to the community, recruiters of new members, and so on; (2) Leaders—drivers of the strategic goals of the community; (3) Subject matter experts—the 'gurus' who guide in developing the community's knowledge base; (4) Content editors—people who are trained to review and approve member contributions to the CoP; and (5) Facilitators—individuals who help community members come together and facilitate communication among them. They form the pillars of a structured approach to learning in an organization.
- (iv) Intelligence sources—these are developed from experts' sharing of experiences, storytelling, and so on. Knowledge reconstruction takes place through analysis of the knowledge obtained by this mode. This process consists of listening to experiences and stories shared and selecting the concept for further consideration. By translating the content into a preferred form for the end user or creating a short executive summary, individuals can analyse the data that they have learnt and heard from somebody or from the expert. Such intelligence sources provide information about broad principles, establishing conformance between new and existing knowledge to reconstruct and update new knowledge learnt through this process. In CoP approach, people share and learn from one another face-to-face, or in virtual mode via online technologies, or both. They have common interest in developing a body of knowledge and share problems, experiences, insights, templates, tools, and best practices from the foremost domain experts in building a common store of knowledge [46]. This maps to the practice element of the Wenger CoP model as they develop a shared repertoire of resources: experiences, stories, tools, and ways of addressing recurring problems.
- (v) Media, books, and peers—this mode refers to knowledge obtained from videos, procedure manuals, sharing ideas by people of the same or different departments, and so on. When knowledge is obtained through this mode, it involves further processing by software tools to codify and structure the knowledge as it could have an unstructured and tacit representation in the mind of the peers sharing the knowledge using CoP [53]. It also involves processes to obtain the knowledge from books and manuals so as to encode and organise the knowledge for storage into a knowledge repository in Step 2. This again maps to the practice element of Wenger CoP model.

Step 2: Hold Knowledge

As seen above, the knowledge obtained from Step 1 could have been constructed through informal and formal processes and hence, this step helps to hold the knowledge as long-term memory for both individuals and organisations. This step maps to the practice element of the Wenger CoP model to develop a shared repertoire of resources. It involves separate processes to hold knowledge in both tangible (Explicit knowledge) and intangible (Tacit knowledge) form within the knowledge repository. It would be required to hold both these types of knowledge throughout their life-cycle, such as when knowledge is remembered or recollected or accumulated as organisational memory, when it is embedded as part of business process and archived, when new knowledge replaces old knowledge, and finally when it is out of date and divested or made inactive as it is of no value to the organization.

Typically, the knowledge repository should be able to hold a storehouse of documents that are gained as practical tips, research reports, and case studies that are shared through the organisation's different CoP approaches in the form of training, workshops, discussion forums, and so on.

In this paper, we provide a practical recommendation of how Step 2, holding the valuable knowledge, can be achieved by an organisation by applying Nonaka and Takeuchi model. Nonaka and Takeuchi introduced the SECI model [24], which lays the foundation of knowledge creation and transfer theory in today's digital world. As it is difficult to capture tacit knowledge as well as explicit knowledge and their varying forms that can be captured using different CoP approaches, we recommend the SECI model for an organisation to hold knowledge. In Table 1, we present the two types of knowledge (Tacit and Explicit) that an organisation can hold by following the SECI model's four process of Socialisation, Externalisation, Combination, and Internalisation within the different CoP approaches. It also provides an illustration to convert tacit and explicit knowledge using the SECI model.

Table 1. Tacit and Explicit knowledge conversion for CoP approaches.

Tacit Knowledge		Explicit Knowledge	
Socialisation (Tacit to Tacit)		Externalisation (Tacit to Explicit)	
-	Sharing experience by using “pull and push knowledge”, storytelling	-	Digital representations of concepts and analogical expressions
-	Mentoring/coaching (1-1, goal setting, leadership)	-	Formulating hypothesis and Modelling
-	Observing and listening to experts	-	Encrypting and decoding knowledge
-	Taking initiatives, solving problems	-	Collaborating with personnel at different levels
-	Watching someone do and follow or practice	-	Translating to source code, communication protocols, etc.
-	Scrum meetings, video conferences, group interviews, brainstorming	-	Using a metaphor for encoding knowledge in database
-	Building shared networks, workshops, training		
-	Facilitating experts to create novel solutions		
Internalisation (Explicit to Tacit)		Combination (Explicit to Explicit)	
-	Acquiring methods of documentation, manuals and system operating procedures	-	Sorting, associating & categorizing data
-	Implementation of operational procedures	-	Updating trust levels and business rules
-	Learning different area of expertise	-	Enhancing transparency and openness
-	Recognizing targets of operation and internalized knowledge maps and data	-	Combining steps, manuals, policies
		-	Summarising from previous projects
		-	News reports and Financial Statements
		-	Securing and accessing CoP Web Portal

- Socialization: Knowledge is passed on through practice, guidance, imitation, and observation and this process of socialization within various CoP approaches facilitates knowledge conversion from tacit to tacit forms.
- Externalization: Conversion of tacit knowledge to explicit forms can be quite difficult though it plays an important process to codify tacit knowledge into manuals, documents, and other digital forms that can be more accessible by more people in the organisation. The use of metaphor is a common technique for performing this process of externalization.
- Combination: Explicit knowledge can be converted to another explicit form using the process of combination where codified knowledge such as manuals or documents could be merged to create new explicit knowledge.
- Internalization: This process of internationalisation is used to incorporate an explicit knowledge learnt into the knowledge repository by modifying the existing tacit knowledge.

Step 3: Pool Knowledge

CoP can facilitate people gathering together to pool knowledge through group meetings, brainstorming sessions, and other collaborative forms [54,55]. Knowledge can be accessed and retrieved directly from the repository and consulted with experts and peers to solve difficult problems in an organization. Some of the approaches like Blogs, Wikis, Avatars, and Social Bookmarking approaches could be adopted to pool knowledge. Search links and other sites can be stored, classified, and shared easily by using social bookmarking techniques. Similarly, using Blogs and Wikis, people can share events or insights with the community using collaborative trust established online. This step maps to the community element of Wenger CoP model in engaging members of the CoP to pool knowledge.

Step 4: Use Knowledge

This step involves using the knowledge from the knowledge repositories created in previous steps for performing tasks, solving problems, and making decisions. Analysis of work processes and embedding knowledge in various work contexts take place through learning and sharing using CoP approaches [56]. Many performance measurement metrics are adopted in this step to evaluate the relevance, use, and efficiency of KM systems. CoPs are vehicles of knowledge diffusion and enable the application of an organisation's intellectual assets in various aspects of the business including project management and process improvements. CoP offers a valuable tool for organisations in evaluating the use of knowledge and maintains knowledge as it helps to create new ideas, decrease the learning curve of new employees, provide faster response to customers, reduce any rework, and prevent redundancies. This step maps to the domain element of the Wenger CoP model in using knowledge in the shared domain of competence or expertise.

4. CoP Implementation Framework

A variety of CoP approaches are adopted in different organizations. In general, we classify such practical CoP implementations under four broad categories [46,57]:

- (i) Internal CoP—These CoPs are formed internal to the organization which could begin to operate informally, but later gets matured to have formal processes in place. An organization may plan for innovative communities where individuals across departments connect with cross-functional views to solve problems creatively using existing knowledge.
- (ii) Networked Organisational CoP—Such CoPs are based on a network of organisations that are related through their formal business partnerships or other existing methods of collaboration. These are supporting organisations that collaborate with each other to solve business problems.
- (iii) CoP Networks—These CoPs are networks formed across organisations with a formal relationship established to share knowledge. These CoPs could be communities that focus on a particular profession or discipline. For example, discipline-based consortiums where organisations participate as members and share best practices.
- (iv) Self-organised CoP—Such CoPs form networks that have no formal operating mechanism but are maintained through ad-hoc relationships among individuals in the network. Individuals who have a common interest form these CoPs. They are knowledge stewarding communities that facilitate in connecting people together.

Overall, CoPs need to be customer oriented or problem focused in order to perform well. Further, to be successful, an organisation must understand how knowledge flows in the network of communities as well as between communities and the organization. This understanding is important for organisations to create, nurture, and sustain these knowledge flows that occur between individuals within the contexts shared by different individuals and groups of evolving communities [58,59].

We present in Figure 2, a framework using the BTOPP model which serves as a high-level guideline for a successful adoption of CoP. BTOPP stands for “Benefits, Tools, Organization, People and Process”.

The BTOPP model was first proposed in “The Corporations of the 1990’s” by Michael Scott Morton, and is used by many organisations as a roadmap to derive business benefits from the introduction of new information technology [30]. We adopt the BTOPP model for CoP implementation as organisations can look for critical information in a rapid and effective manner by answering the key questions pertaining to Benefits, Tools, Organisation, People and Process that can have an impact on KM success factor. We provide below key guidelines in adopting BTOPP model in this context.

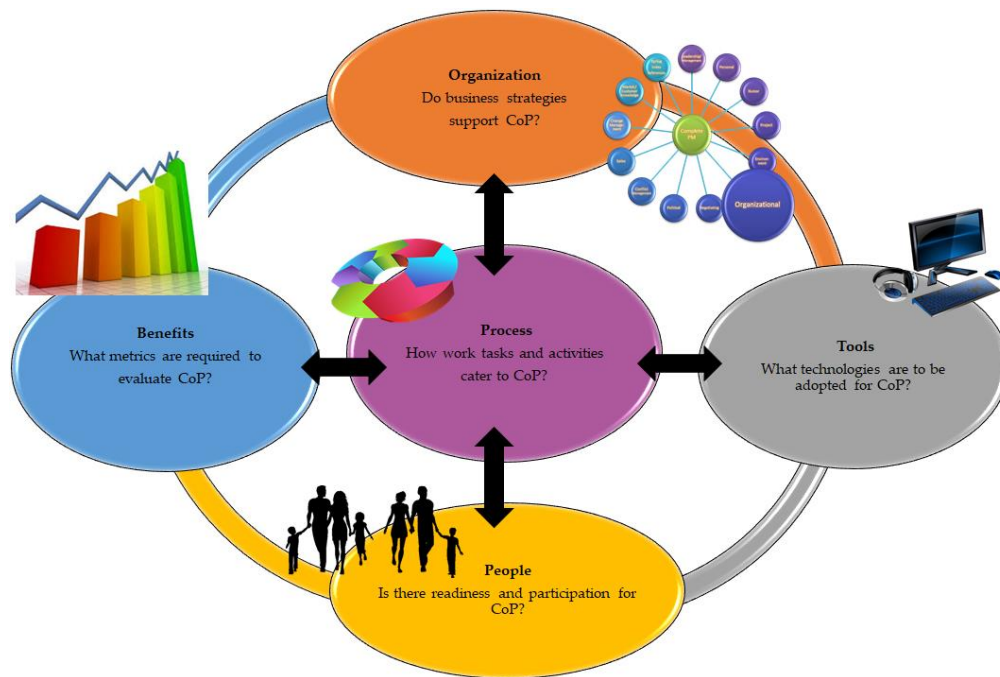


Figure 2. CoP implementation guideline using the Benefits, Tools, Organisation, People and Process (BTOPP) model.

4.1. Benefits

Knowledge management is expected to provide various benefits to individual employees and to the organization including employees and customers [23,46,60]. Although there is an establishment of relationship between knowledge and practice, the leading purpose of CoP approach to KM is to bring value to an organisation. Some of the key benefits of adopting CoP as a KM strategy are listed below:

- Facilitates collaboration and effective networking
- Provides opportunities to contribute
- Cross-fertilizes ideas and increases opportunities for innovation
- Assists people to be up-to-date with knowledge of products and services
- Develops professional skills to solve problems quickly
- Results in efficient organisational decision-making
- Builds organizational memory and diffuses best practices
- Enables organizations to have a competitive advantage

However, one of the biggest questions when investing into CoP is how to measure its value for the organization that can be addressed by answering by the following question:

What metrics are required to evaluate CoP? Our recommended strategy to answer this question is as follows:

Develop Quality Culture—Cultivate a corporate quality culture in establishing social structures for knowledge sharing through quality interactions and meaningful discussions. Develop metrics for

the quality assessment of the organizational learning as well as effective use of knowledge, tools, and techniques in the CoP. Assess the quality in web portals and e-learning tools such as recorded PowerPoint presentations, video conferencing, online coaching/tutorials, and so on.

4.2. Tools

In the context of KM, the tools used could be of various nature: Information Technology (IT) based tools and strategy based non-IT tools. However, in today's digital world, even non-IT tools require the right technologies for effective CoP implementation. Hence, choosing the right tools in CoP will go a long way to help organisations fulfil their KM goals [53]. Some of the tools that could be effectively use in various CoP approaches are as follows:

- Groupware and other collaboration tools which are essential enablers of knowledge flow and knowledge-sharing activities among the people who participate in the CoP.
- Data mining and knowledge discovery tools which can be used to “discover” or identify emergent patterns that could not have otherwise been detected. These techniques when adopted in various CoP approaches provide valuable insights into the tacit and explicit knowledge created through the SECI model.
- Knowledge repositories which form the most frequently used tool is the most visible aspect of a KM technology adopted in CoP. Organisation make use of their intranet and a KM database to store their knowledge repositories and share them.

Recent emergence of wireless technologies have resulted in the development of new tools that make use of mobile information and communication technologies (ICT). These tools challenge the traditional practices of document management to take innovative steps for their effect use. Their impact on CoP approaches for retaining knowledge as part of organizational memory is yet to be explored fully. Hence, a relevant question raised in this context is:

What technologies are to be adopted for CoP? To answer this question, we recommend the following strategy:

Leverage on Technology—Effective use of technology in CoP would help to acquire the tacit knowledge from the domain experts through online discussions, chats, forums, blogs, and so on. We recommend the use of automatic acquisition techniques to extract tacit knowledge from such implied expert knowledge and store in the organizations' data warehouses [61]. However, the size of the data warehouses would become very large and any data mining or discovery mechanism may pose issues. Our recommendation is to manage these technologies through appropriate processes, methods, and techniques such as summarization of tacit knowledge gained and other methods by adopting the Wiig KM cycle.

4.3. Organisation

The focal point of KM in an organization is to determine how management functions are structured in an organization, including support functions such as Human Resources and IT Services. The structure of an organisation influences the effectiveness of CoP as a KM strategy. Hence, CoP needs to reach out to all the different parts/functions of the organisation, and it needs to be supported by the management [44,51]. Organizational structure determines the manner and the extent to which “the roles, power and the responsibilities are delegated, controlled and coordinated”, and how the information flows between the levels of management. Some of the questions raised to determine a suitable organization structure and business strategy to support CoP are as follows: What are the CoP projects and reporting structures? What are individual/team responsibilities? Where are they are located and who do they report to? The various types of organizational structures adopted for CoP are:

- Informal reporting structure where employees take into voluntary membership of CoPs and this can result in multi-disciplinary members forming groups and project teams. Here, the people's effectiveness is based on trust development.
- Formal reporting Structure which supports in generating, capturing, storing, and sharing knowledge with accountability assigned to CoP members.
- Empowered department structure which can result in increased capacity for improved action when members of CoP are highly motivated as they adopt an empowered leadership style.

Before embarking on KM, the management may wish to understand what the popular CoP approaches are, and how to employ business strategies to support the CoPs and the communities to link to one another. Hence, the management of an organization would like to answer the following question:

Do business strategies support CoP? Our recommendation is that the management should adopt a corporate culture with a set of understanding that members of a community should share in common. This would help to align their business strategies to support CoPs and the knowledge flow within an organisation as follows:

Establish Purposeful Relationships—Create and support member directories with relationship-based data fields that can link to the member profiles in the network. A social network is a set of interconnected people who directly or indirectly interact and influence each other. Businesses are using social networks for various reasons, and organisations could make use of such popular networks to discover and establish their CoPs. Organisations adopt social network analysis to examine what type of knowledge is being exchanged and the pattern of its exchange within the organizational structure. This would facilitate not only to discover the barriers to knowledge exchange but also to identify areas of the organization that need better integration into the knowledge network. Knowledge mapping and folksonomy help in establishing purposeful relationships in CoP through classifying online content into different categories. Collaborative tagging content on the web is often done with social bookmarking and metadata so that people with similar interests could form purposeful relationships in the CoP.

4.4. People

It requires organizational change for making people to share knowledge and to get themselves comfortable with the idea of KM. Staff should be able to see the benefits of sharing knowledge with other employees. Employees already overworked in their daily tasks may not be willing to participate in knowledge sharing activities [19,20]. Organisations should embark on ways and means to keep people motivated with the idea of knowledge management. They need to be given training as well as staff autonomy on their jobs to innovate new methods to fulfil their tasks. When people participate in CoPs, some of the outcomes are:

- Enhanced communication within the organisation
- Increased participation of employees in business decisions
- Faster delivery of cost effective projects
- Reduction in the problem-solving time
- Improved productivity.

The organization requires to adopt good change management strategies to prepare the staff for embarking on CoP approaches for KM. If there is resistance among people in using KM tools and technologies, then they need to be provided with sufficient and focused training [27,52]. The management should endeavor to answer the following question:

Is there readiness and participation for CoP? To answer this question, we recommend the following:

Encourage People Participation—Organisations should encourage staff to engage in collaborative learning and knowledge sharing. Existing practitioners should be motivated to undertake reflective attitude so that such reflections when shared would benefit members of the community in an

organization who should also be encouraged to participate and provide feedback. Create various focus groups and subgroups that can allow members to self-join and participate. If the usage of such CoPs is included in the job definition, people would be able to contribute more certainly. This could be facilitated through projects, where certain knowledge items could be reused as part of the project tasks. Another way to motivate staff participation is by introducing goal and rewards system. Each employee's individual goals and targets could be linked to their level of contribution in CoPs. Feedback systems could be developed to encourage people to create innovative ideas and suggestions to improve the workplace tasks. The emphasis should be on the quality of the contribution rather than the quantity. Relevant ongoing training opportunities should be provided to employees as part of their professional development.

4.5. Process

Many organisations plan for KM with a 'physical' community by providing shared document repositories and databases, and only some organizations provide virtual community spaces for synchronous or asynchronous communication and the sharing of tacit knowledge that can facilitate the development of CoPs [19]. Knowledge can be pooled and used in a variety of different ways to provide support with key enabling features as listed below:

- Capable of holding large amounts of data in various formats with easy search facilities so that employees can make use of them in their work processes
- Reasonable response times for downloading large data files so that these repositories can be utilized for real-time problem solving in projects
- Secure access to knowledge so that integrity and authenticity of knowledge is maintained even after different people reuse in in several work related processes

Employees will be able to see the benefit of intellectual capital reuse depending on the context and the purpose in which knowledge can relate to their work processes [2,5]. Hence, it is important to ask the following question that will help an organization to align the business processes for effective CoP implementation:

How work tasks and activities cater to CoP? We recommend that organizations follow the business strategy given below:

Embed KM processes into Business Processes—Re-engineer the business activities to cater to CoP by embedding KM processes into work related processes. For successful use of both the physical and virtual community spaces, organisations need to implement the internal work processes to be aligned with the following KM processes:

- Knowledge Discovery & Detection: Organisational knowledge resides internally and externally. Knowledge detection includes the various processes of identifying the knowledge sources that already exist, as well as discovering hidden knowledge that is within the data and information. These processes should be embedded within the employees' work tasks and activities.
- Knowledge Organization & Assessment: This is the process of mapping, categorizing, indexing, as well as evaluating the knowledge assets of the organisation. The IT department of the organisation should deploy the necessary software tools to facilitate automatic and easy categorization and retrieval of knowledge from the organisation's knowledge assets in a variety of ways that are appropriate for the job-related processes.
- Knowledge Sharing: In CoPs approaches, knowledge sharing is the most significant KM process directly related to job-related process leading to the creation of knowledge as well as knowledge reuse.
- Knowledge Reuse: In every work activity, three roles can be identified—(i) knowledge producer for knowledge creation, (ii) intermediary for knowledge preparation, and (iii) consumer for knowledge reuse. These can be embedded into business processes through sharing of personal

experience, formal education or training, peer-knowledge, and intelligence gained from all work related sources.

- **Knowledge Creation:** This process depends upon knowledge sharing, collaboration, and access to the relevant information and data. The role of management is to create work related environments suitable to the type of CoP adopted. Establishing work-based access to the relevant data and information from various sources such as structured data warehouses, digital stories, and idea banks is important in order to integrate the knowledge creation process with the business process of the organisation.
- **Knowledge Acquisition:** Knowledge can be acquired both internally and externally using CoP approaches that include Web conferencing, online discussions, online meetings, expert knowledge bases, and search tools with various stakeholders such as customers, partners, suppliers, competitors, and mergers. When these sharing sessions are directly integrated with the job activities and work tasks, there will be more willingness to share and acquire knowledge, thereby reaping the benefits of CoP.

5. Challenges to CoP Implementation and Recommendations

CoP approaches have been adopted to support collaboration in many organisations as a KM strategy to improve knowledge generation and dissemination. According to Wenger CoP model, there are three essential structural components for a successful CoP implementation. They are:

- (i) Sponsorship—management to sanction time allocation and promote cultural acceptance
- (ii) Recognition—to allow identity development and build recognition beyond teams and task groups
- (iii) Support—to provide funds, technology infrastructure and guidance.

Despite the above structural components in place, several studies have also reported challenges that form barriers to their successful implementation of CoPs [19]. Some of the barriers identified are resistance to knowledge sharing, work overload, lack of management support, technical issues using the IT tools, lack of time, non-clear benefits, and conflicting priorities between CoP and business functions. We identify key challenges under two main categories: Organisational Culture and Performance Measurement and provide recommendations to overcome these challenges.

5.1. Organisational Culture

The most difficult constraint that organisations face in the successful implementation of CoPs is to establish the right organisational culture. Some organisations have introduced change management programs to encourage staff participation in CoPs and to share knowledge with a positive attitude. Many organisations provide an induction training for staff to understand the tools used for CoPs. Some organisations also adopt business process re-engineering methods to link the KM activities of CoP with the work tasks and business processes. However, with dynamic changes in the business and staff turnover, it is important to continuously recognise and monitor organisational change in achieving the desired organisational culture required for a successful CoP adoption and for reaping the benefits of KM.

Recommendation:

The concept of social networks was introduced in early 20th century that depicts relationships between members of social systems. Recently, organisations are using social media for business knowledge gathering from the network [62]. The nodes in the social network are knowledge entities such as people, groups, organisations, computers, websites, and so on. Typically, each CoP is a social network with a particular purpose in the KM strategy of an organisation. We recommend organisations to adopt social network analysis (SNA) to provide an understanding of the relationships between the knowledge entities of the CoP. SNA provides visual and mathematical analysis of these knowledge entities. The mapping and measurement of relationships between members of the CoP and

its knowledge flows would help the organisation to understand the networks and their participants. The SNA measures can provide insights into the various roles and groupings in a network. In the past, SNA tools were not sophisticated to include such insights. With Big Data evolution and data analytics developments, SNA-generated insights are more recently being designed. For instance, SNA can be added to the current tools of online collaborative learning to monitor and support teaching and learning in higher education [63]. This way SNA could be adopted not only to ensure the intended pedagogical goals of online learning but also to monitor cognitive, social, and motivational outcomes by using various statistical analysis [64].

Organisations could use SNA for various purposes: (i) to understand the skills and experiences possessed by the members of CoP; (ii) to know who the connectors, mavens, leaders, bridges, and isolates are; and (iii) to know who is in the core network and who is in the periphery, and where the key clusters are. Figure 3 gives an example of SNA showing the clusters of the network in different colours and the people who participate in different clusters. SNA would help organisations to bring about the right organisation culture for CoP. The knowledge flow analysis metrics of SNA can be developed to understand how the organization has used or shared the knowledge and to even identify for which tasks the employees have shared the knowledge. It can be employed to find out if the type of knowledge held by a person is important to the work and whether it is easy for others to access it. Such information helps the organisation to identify bottlenecks in their organisational culture and to make the necessary transformation for change. By monitoring the knowledge networks using SNA, the organisation can reorganize the work structures, provide support in knowledge transfer, and introduce a shared goal for the CoP so that members can collaborate and work towards a business theme of interest.

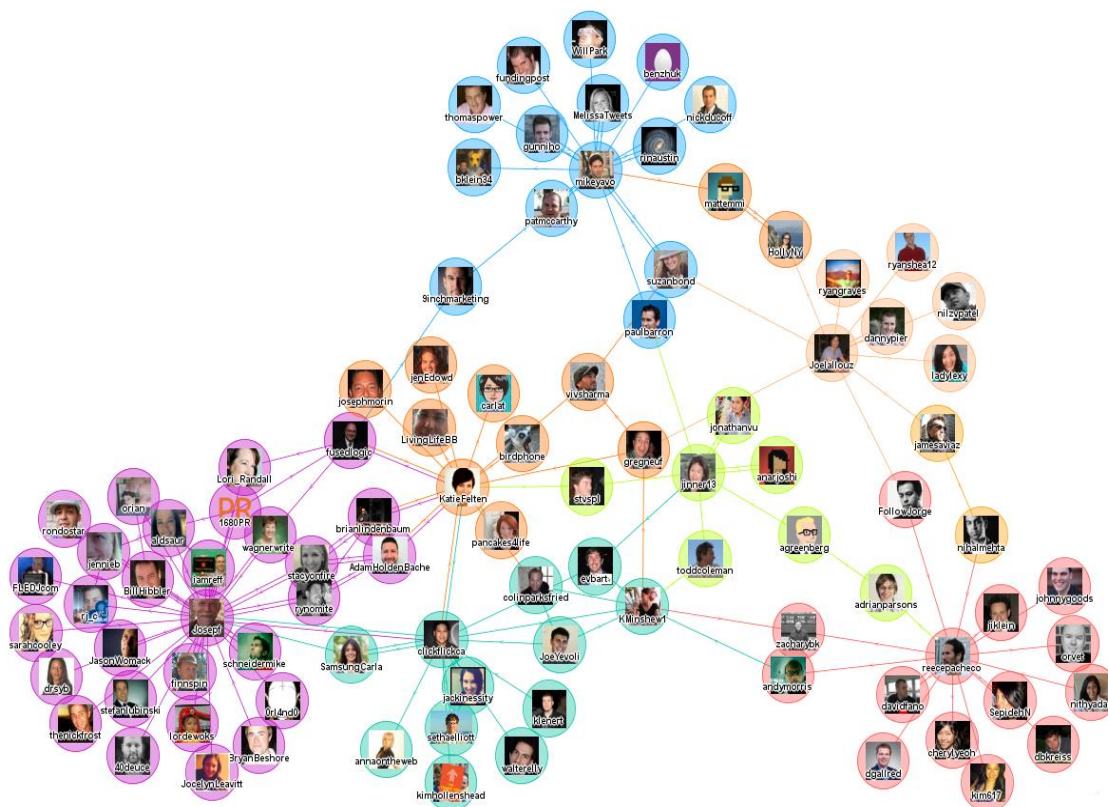


Figure 3. Illustration of a social network analysis (SNA) graph of the knowledge network in a CoP.

5.2. Performance Measurement

One of the critical challenges for most organisations is to demonstrate the benefits of CoP in their KM pursuit. This is due to the difficulties in explicitly linking KM with business strategy.

While organisations have demonstrated introduction of KM initiatives through CoP approaches, they have not put in place methods to evaluate the contribution of such activities towards business improvements. A recent review on the impact of CoPs on the preventative health workforce report that the existing methods used to evaluate CoPs lack rigour and does not provide true impact of CoPs on population health [50]. There is a need to establish a shared goal of developing and aligning KM strategy to business objectives. Organisations need to monitor and communicate the KM benefits through the performance metrics, which can help in increasing an understanding of the level of staff awareness, and the recognition of reform required to address the existing barriers.

Recommendation:

We recommend a structured approach to facilitate and benchmark the implementation efforts in terms of management support, staffing, and budget allocated for KM initiatives. Key performance indicators or performance measures are metrics used for assessing the impact of CoP as a KM strategy. Organisations should develop such metrics to evaluate the effectiveness of each KM initiative. Performance measurements can help to identify areas where no intellectual capital currently exists in the system or the level of participation in CoPs has not been met. Specific assessments could be performed on various KM activities and the degree to which they link to each business process. For instance, a CoP initiative that involves customer feedback or sharing online shopping experience could be measured. Online behavior analysis of consumers could be performed using appropriate mathematical models and metrics [65]. This way KM performance measurements can be aligned to measure the core business objectives to realise the benefits of CoPs. If a KM initiative involves CoP activities such as participation in Professional Development Webinars, the targeted audience of the event may require to complete a pre-event survey, feedback session, and a post-event survey. Both quantitative and qualitative metrics could be designed to assess the participation level, perceived relevance to their job, and actual application of the knowledge gained in work tasks.

The most important characteristic to consider when choosing or defining a KM performance measure is that the metric should relate to the knowledge being shared and used [21]. Three types of metrics that need to be suitably defined and employed are: (i) System Metrics, (ii) Output Metrics, and (iii) Outcome Metrics. We illustrate these three metrics in the context of conducting a performance measurement with regard to evaluating the usefulness and responsiveness of a support technology in CoP. System metrics such as Number of contributions and Contribution rate over time could give an indication of the amount of knowledge shared and reused. Other metrics could also be developed to identify which knowledge assets are the most popular ones and which have usability problems. Output metrics such as Number of problems resolved and Time taken to resolve could measure the use of knowledge at the project or task level. Outcome metrics such as Savings in time/money and Improvement in quality/efficiency of a business process or a group project could provide a measure on the impact of the KM project or initiative of the organization. They measure large-scale characteristics such as increased productivity. With the availability of technologies of Big Data and data warehousing, intelligent data mining techniques could be adopted to gain deep insights using such performance metrics with the tangible and explicit knowledge gained through CoPs [28,47,66].

Figure 4 shows a 3D line chart illustrating a possible trend in key performance indicators of the organisation's KM initiative over a period of time. The blue line indicates the system metrics showing an initial high response of contributions within the first 10 days and then falling gradually. An email reminder was probably sent soliciting contributions on day 20 which resulted in an increasing trend, and after 30 days the response decreases rapidly. The grey line illustrates the growth of output metrics on the number of problems resolved after introducing the KM initiative. Within 20 days, this metric has increased, but slowly, then in the next 10 days the trend improves and finally there is a significant increase in the metric for the following 10 days. The orange line shows a steady and consistently increasing trend of the outcome metrics such as money or time saved throughout the 40-day period

of monitoring. Hence different performance metrics could be used for gaining insights into the KM initiatives of the organisation.

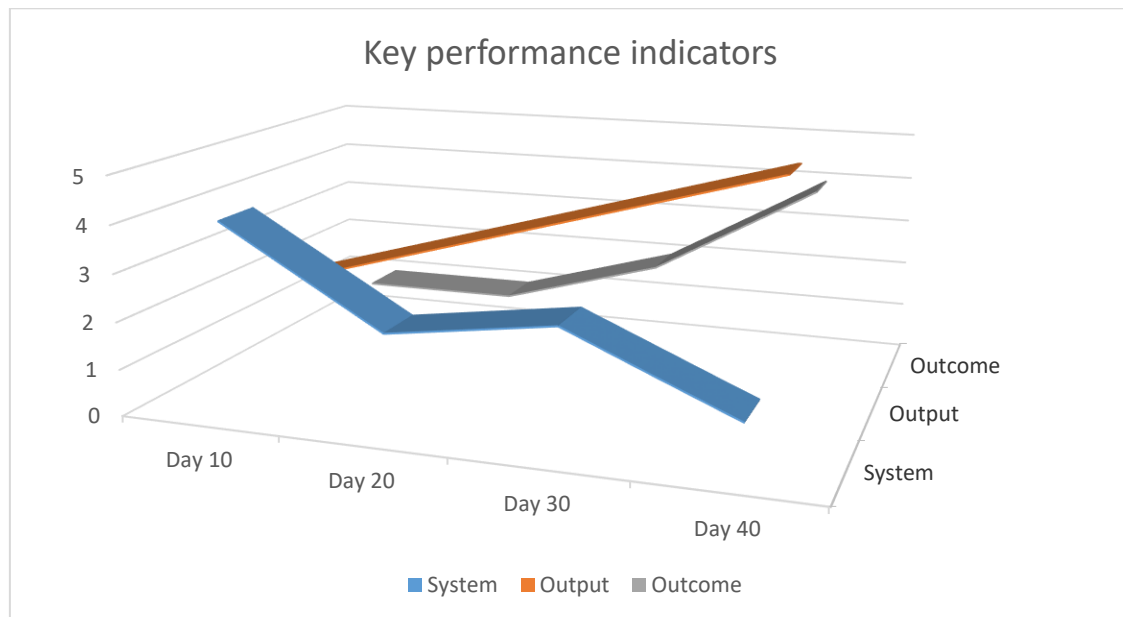


Figure 4. Illustration of Performance measurements for KM initiatives.

Overall, organisations should encourage and facilitate formal and informal knowledge sharing activities to create new intellectual capital of interest. Both SNA and performance metrics could help organisations to assess the effectiveness of their KM initiatives. They provide feedback on the usage of the system and the level of knowledge reuse in business processes. Evaluating the content management of the intellectual capital as well as the organisation's culture towards knowledge sharing is essential to understand the areas where benefits of KM have been realized as well as those that require improvement.

6. Conclusions and Future Research

The concept of CoP is perceived to make a valuable contribution to the sharing and diffusion of knowledge by connecting people together. Many organisations treat CoP implementation as another project by leveraging on technologies. While a project also brings people together to work in teams, sharing and applying knowledge to solve a problem, the activities are undertaken in a structured manner within the project boundaries, which is in contrast to CoPs where there are no clear-cut boundaries, and the objectives emerge as the participation progresses. Hence, the organisations have difficulties in identifying an appropriate CoP implementation framework. Further, with organisations entering into a competitive digital economy, CoP approaches adopted in KM systems require a revisit and review for a successful and sustained implementation. This research has aimed to address these challenges by proposing a CoP implementation framework for a successful KM strategy in an organisation. The fundamental role of CoP in KM systems was revisited in today's context and an effective mechanism of applying Wiig KM cycle for CoP with an emphasis on building, sharing and using tacit and explicit knowledge was explored following the SECI model. The proposed CoP implementation framework was developed by adopting the BTOPP model for incorporating various practical knowledge sharing techniques. Finally, key barriers of CoPs that relate to organizational culture and performance measurement were discussed with recommendations to overcome them. Practical measures to continuously improve and sustain CoP implementations were illustrated with the focus on the organization's KM strategy to complement and add value to the business operations.

This research could trigger and point towards additional areas related to CoP that could be of interest to KM practitioners as future study. Understanding the dynamics of interactions in the virtual communities, facilitating the participants to tap on their creativity and many other dimensions of CoP to enhance collaborative KM across time and distance need further exploration.

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