# Knowledge processing, codification and reuse model for communities of practice[1]

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**ABSTRACT**

Knowledge Management (KM) has been a widely received area for research and development for many decades. However combining the full Knowledge Management Cycle; knowledge capture, development, sharing and utilisation within the same infrastructure has not been successfully researched and a suitable remedy all-in-one application for virtual communities or Communities of Practice (CoP) has not been established. This article proposes models for knowledge analysis, knowledge processing, codifying and reuse, and finally elaborates on research prototypes that are being used in virtual community settings (i-FAB Community*, INTUITION Network**) for gathering knowledge management requirements of such environments. Further research works are also discussed in application of KM infrastructures and Virtual Machine Architectures within future workspaces.

**Keywords:** Knowledge Management Infrastructure, KMLC, Knowledge Production Life Cycle, CoP, Virtual Machine Architecture

***i-FAB Global Community**

i-FAB is an international collaborative activity initiated to impact on the related knowledge creation, dissemination, utilisation and industrial harmonisation of the foot and ankle biomechanics community. i-FAB has members from every community related to foot and ankle biomechanics, from academics, physicians, surgeons, and health professionals, to members of the footwear, insole, surgery and related industries. i-FAB has an open philosophy and one of its key objectives is to connect people (through 'Collaborative Workspace' and 'organised activities') across traditional disciplinary boundaries as one of its key objectives.

****INTUITION EU Network**

The INTUITION project is a Network of Excellence focused on virtual reality (VR) and virtual environments (VE) applications for future workspaces (FWS). The INTUITION Network consists of groups of communities (Communities of Practice) who are interested and actively working within the VR and FWS related areas.

## 1 INTRODUCTION

Knowledge sharing has become one of the most valuable interfaces between Communities of Practice (CoP) and it is seen as a critical factor for the long-term existence of each community. Managing knowledge within the community and what is to be shared with other communities are governed by the community structure and the virtual culture that they have established over time. Recognition of 'people perspective of knowledge and its management' has made the realisation of knowledge related processes less complex than otherwise [1][2][3]. Although some argue that multifaceted nature of knowledge sharing will typically be a complex process even under the best of circumstances [4][5]. The knowledge related processes such as; knowledge creation, identification, storage, valuation, sharing, transfer, acquisition, community learning, distribution, dissemination, etc. are all very much interdependent Knowledge Management (KM) procedures that each community member or group act and react to on a daily basis. However out of the above processes one could consider knowledge creation and transfer as the primary factors which encapsulate the rest. The appropriate facilitation of knowledge storage can amplify all the other processes while protecting the individual or group ownership of the content and the depth of sharing.

Knowledge exists at multiple levels within CoP. Starting from individual level then groups within

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communities and finally extending into large communities that consist of many groups. While the individuals become the most important of all [6] the interaction between individuals within different groups (including the peer group) facilitate knowledge creation. The above authors also argued that individuals or groups who decide not to share a piece of knowledge then that particular knowledge will have a limited impact on the effectiveness of their community. On the other hand based on the realisation of value or expected value of that piece of knowledge this may not be suitable for sharing for the good reasons. This is further explained later in the knowledge processing model detailed. Three types of knowledge; know-how, know-what and dispositional have been identified at the individual level and are all important in value creation [7] within the community. The individuals who connect with the community by offering the knowledge that resides within individuals are converting the knowledge into economic and competitive value for the community [4][8]. Different individuals with diverse experiences and knowledge within CoP have the ability to innovate and create competitive advantage if the community could support for a framework for those individuals to exchange, evaluate and integrate their knowledge by working towards a common theme or facilitating them into a close working environment [9]. Such a framework is considered as a community asset which will not only manage knowledge of CoP but also harness knowledge creation and sharing as a key capability of the community. This paper explores knowledge creation, aggregation and reuse processes that support facilitation of knowledge sharing within communities of practice or virtual communities. As a primary issue this paper analyses knowledge creation process within an individual, virtual groups and the community as a whole. This has led in proposing KM related models and definitions that are applicable for CoP. A system prototype is being created and being used for further analysis of community requirements in a lively manner within large scientific community projects that consist of industrial partners, scientists and academic members.

## 2 RELATED WORK

The IT systems developers have created many tools for supporting KM operations that cover four basic steps in KM life cycle to some extent and those tools could not provide complete facilitation of capture, development, sharing and utilisation of knowledge [10]. This has forced communities to adapt set of KM tools to cover the full life cycle of KM when the community has recognised that this behaviour within their community as being highly valued. The KM architecture model defined by [11] describes the requirement of using multiples of tools for supporting the full life cycle of KM. Knowledge development and utilisation have not been successfully addressed within many KM tools.

### 2.1 ICT Infrastructures To Support The Complete Cycle of KM

The system developers and researchers must work together to design more innovative mechanisms and interfaces for knowledge development and utilisation of the future KM systems infrastructures. While these two steps (out of 4 basic steps) require much higher attention the maturity of current and immerging technologies has provided the confidence that the knowledge capturing and sharing can be achieved to a greater degree of success. Providing a single KM infrastructure (KMI) with intelligence interfaces to facilitate the complete KM life cycle within a virtual community will be an important goal to achieve. Several advancements have been achieved by researchers and developers. A digital library infrastructure called Collaborative Knowledge Evolution Support System (CKESS) has targeted managing knowledge of communities. CKESS knowledge support system has addressed many issues related to developing a community knowledge repository of an evolving nature [12]. Theoretical base Online Community Framework (OCF) elaborates issues of capturing community requirements as a whole so that systems designers could support these needs through the ITC systems [13]. How well the designers can support sociability and usability is the main focus of OCF. Applications such as over a decade old Arthur Andersen's world-class knowledge base [14] of Global Best Practices (GBP), and recent development of Oracle's J D Edwards EnterpriseOne confirms the growing importance in designing of integrated information and KMIs and the path it has taken to the current date. There are many other numerous systems and design methodologies which have surfaced in focus of developing KMIs as this subject area 'organisational KM' has become a major global economic driver for many businesses. While one could consider that these designs, methods and tools established have been highly contributing to its cause successfully, many gaps still exist in the development and implementation of KMI that could support the full KMLC. Some of the interesting aspects of this nature which have been addressed by Firestone and McElroy include describing a Distributed Organisational Knowledge Base (DOKB) associated concepts in their textbook [15]. Web Ontology Language (WOL) based development platforms (E.g. Protégé-OWL), Semantic Web Rule Language (SWRL) models, etc. have also contributed for designing rule-based KM systems that focuses on business applications [16]. Technical and infrastructure challenges have made development of KMS from scratch a difficult process. However developers today can rely on integrating enterprise grade technologies such as JEE, EJB, Java Architecture for XML Binding (JAXB), and JBoss/Tomcat servers [17] operating under Linux AS environment as a superior starting point. The above researchers have demonstrated a prototype KMS developed under this platform. Their proposed automatic component generation of Knowledge Object Management (KOM) has made this KMS easy to reengineer (with improved reusability) for different domains. The research prototype used in this work is also engages a collaboration development environment based on similar architecture.

The innovative tools of the future that are integrated with KMIs should provide features to facilitate knowledge availability and analysis (tools) to ascertain the value of knowledge for those who seek for a specific content at the right time. While one could consider that the above discussed systems and tools have been highly successful in their time many gaps still exist in the development and implementation of KMIs that could support the full KM life cycle.

### 2.2 System Prototyping For Gathering Requirements Of Full KM Life Cycle

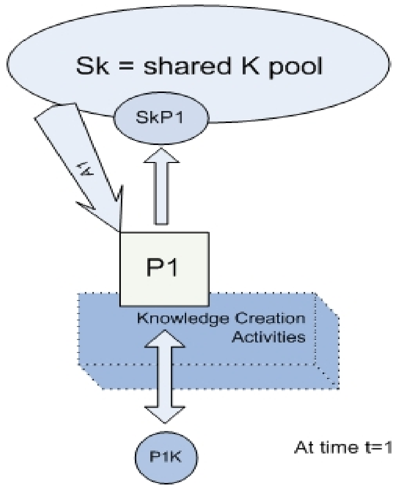
In order to address much of the above issues and establish a suitable KMI for the scientific and professional communities a prototype version of a Knowledgebase Infrastructure [18] has been developed and utilised within large scientific community project environments. This prototype is used as a requirement gathering engine to capture, discuss and finalise user needs of such communities and where time permits to implement these findings in the future prototypes in an iterative prototyping process.

## 3 THEORETICAL BASE FOR KNOWLEDGE CREATION AND CODIFYING FRAMEWORK

Knowledge in communities is classified into two types; tacit and explicit by considering its very nature. In three major areas; codifiability and mechanisms for transfer, methods for acquisition and accumulation, and potential to be collected and distributed, has seen the critical differences of the above two types [19]. EgoChat system investigates ways of sharing tacit knowledge [20]. The tacit knowledge is very much attached to the individual who owns it and it's difficult to codify while explicit knowledge can be codified, stored and shared independent from the owners' involvement. This does not imply that explicit knowledge is readily available for sharing as needed [8] but with the appropriate knowledge sharing mechanisms in place that could be facilitated within the community. The ability to articulate knowledge within or between other communities also depends on whether the knowledge is rationalised or embedded [21] and whether any value is attributed to its content. When knowledge becomes a valuable commodity, what knowledge to share, when to share it and with whom to share it becomes very important decisions to make [22]. While certain types of knowledge which are valued highly by the community and the individuals but resides relatively in a limited number of individuals [23]. Even such knowledge must be shared among the authorised individuals and utilised promptly by taking the appropriate actions so that the higher impact could be achieved. Suitable KM framework can control the availability and depth of accessibility of such value attributed knowledge so that only the appropriate content is shared or becomes available among the intended recipients.

### 3.1 Shared Community Knowledge Pool And Aggregation Of Knowledge Within Individuals

Knowledge creation activities inherently requires to absorb related knowledge from different sources and then that content interacts with individuals (one or many working together) own knowledge of that specific subject area(s). So, an individual's ($P_x$=Person *x*) knowledge (K) at a specific time, $P_xK$ can be given as; $P_xK = \Sigma$ (held knowledge of a specific subject area); where Σ been used to consolidate and capture the knowledge of many subject areas that an individual ($P_x$) has retain. With the assumption that the Shared community Knowledge pool (Sk*n*) of *n* number of members is able to create their own self sustainable knowledge creation and management activities by absorbing knowledge from the Sk*n* and within post creation by supplying the newly created knowledge back into the Sk*n*. The following figure describes knowledge sharing, knowledge absorption and working knowledge of an individual engaged with a specific knowledge creation activity. As in figure 1 and described above at a given time the knowledge held by an individual ($P_x$) is $P_xK$ and the amount of shared knowledge or post creation knowledge contribution to the Sk*n* by that person is $SkP_x$. In a different point of view this can be expressed as; $Skn = \Sigma$ ($SkP_1$, $SkP_2$, $SkP_3$ … $SkP_n$); where Σ been used to combine knowledge contributions of the community of *n* knowledge sharing members. The knowledge an individual requires absorbing to perform a specific task (knowledge creation activity) from the K pool (Sk*n*) to call $A_1$. The knowledge required to absorb (A) could directly have an association with the intensity of knowledge lacking and/or type of knowledge creation work that the person involved at the time individually or as a part of a group. The individual's involvement within knowledge creation and management process described is to be named Knowledge Production Life Cycle (KPLC). Knowledge creation activity within a group setting




$P_1$ = Person one

Sk = Shared K pool of the organisation

$P_1K$ = Person no.1's pre-knowledge

Knowledge creation activities = Any knowledge creation activities an individual involved (personally or within group environment)

$A_1$ = Received (or Absorbed) knowledge from the K pool for completing K creation activities

$SkP_1$ = New knowledge to be shared during post knowledge creation activity

**Figure 1:** Knowledge creation activities related knowledge aggregation (of an individual)

will be discussed later.

Knowledge creation and sharing as discussed above can be seen as a two facet movement; on one side it benefits the community for moving forward in accordance with their goals and visions and on the other side it serves as a knowledge pool that members of the community can constantly gain knowledge from the pool for their own advancement. Therefore knowledge sharing at its best can be seen as a controlled knowledge pool that accumulates knowledge from individuals (or groups) where the individuals can receive, aggregate, create and then supplying back the new knowledge to the pool. Considering these characteristics sharing of knowledge can be viewed mathematically as discussed later in this article. Individuals working together (dynamic working units engaged in knowledge creation activities) constantly share knowledge but not every piece of knowledge reaches the shared knowledge pool. The group or an individual must take the opportunity to codify that knowledge and make this available for others authorised to receive that content (or objects). However many artefacts may exist (predefined deliverables or voluntary group work), that virtual groups create together which capture their knowledge of a particular subject matter so that these objects can be included in the knowledge pool on a timely manner.

Much of the knowledge created within a virtual community is based on virtual teams (or groups). While some individuals may be involved in knowledge creation activities by themselves many others engaged with different activities, associated with different groups. The figure 2 shows an integrated version that includes the individual knowledge creation activities or KPLC described in figure 1 within group environments which are spread among virtual teams. As an example a virtual team of two people ($P_1$ and $P_2$) can engage in knowledge creation activities in order to deliver new knowledge for the community or for their own benefit. During post completion of this activity they may share a codified version ($SkP_1+SkP_2$) that contains the created knowledge among the virtual community by incorporating this object in the Sk*n*. It is assumed that only the appropriate users are able to access this information on a timely manner.

### 3.2 Knowledge Aggregation Algorithm For n People Within The Community

The following (a) and (b) recaptures KPLC for the individual and its implication on the K pool as two important points of interest where knowledge aggregates for further analysis.

(a) KPLC within an individual ($P_x$)

An individual is likely to receive ($A_x$: Absorb) knowledge from the knowledge pool in order to complete the activities in hand. For the simplicity the knowledge gained from another individual directly is not pictured above but assumed as this type of knowledge also reaches the individual via the knowledge pool. The individual's prior knowledge (at time $t$=0; $P_xK$) is likely to react with the absorbed knowledge for creating new knowledge, concepts and ideas. This new knowledge created to be shared by moving back to the knowledge pool, fully or partially, if that seems appropriate at the time.

(b) KPLC and aggregated group contribution to shared knowledge pool ($\Sigma\ Skn(t)$)

Individuals within working groups are likely to share their knowledge of a particular interest by making it available in the shared knowledge pool by some means of codifying the knowledge content. In a given case this may be in the form of an artefact that few individuals have worked together (virtually connected, co-located or a combination of two modes) and decided to share it by making that

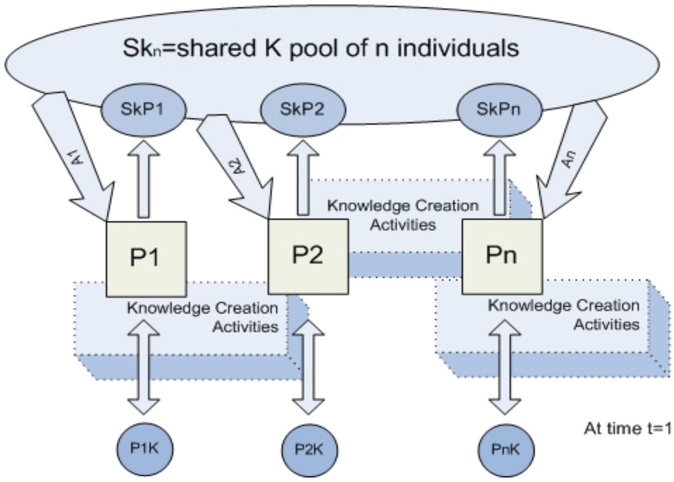



**Figure 2:** Group knowledge creation activities and knowledge aggregation

artefact available in the knowledge pool. At a given time many individuals or virtual groups who work together on various knowledge creation activities also share similar contents accordingly. This concept automatically facilitates knowledge aggregation within the knowledge pool as well as within individuals (as discussed in (a)) who may require receiving the newly available knowledge as needed basis. Assuming there is only limited resistance for knowledge sharing (based on the value of created knowledge) individuals frequently create new knowledge and make it available in the knowledge pool for community access. Over time the community will be equipped with a valuable aggregated knowledge pool and this will become a key capability of the community for achieving their goals and objectives.

Knowledge creation activities relating individual and group human processors in the light of quantifying the Knowledge Creation Process (KCP) of virtual communities is a novel idea. Tacit and explicit knowledge transferred among individuals in a group and different modes of knowledge creation [24] have been explored by researchers. They have described a 'web' of knowledge management activities in organisational settings and propose a conceptual foundation of a KM framework. The KCP within an individual, how this process inter reacts with the community setting and knowledge aggregation within individual and community knowledge pool has not been explored and the literature shows many gaps in this area. In order to fulfill this requirement figure 3 analyses the KCP within an individual and provides a knowledge

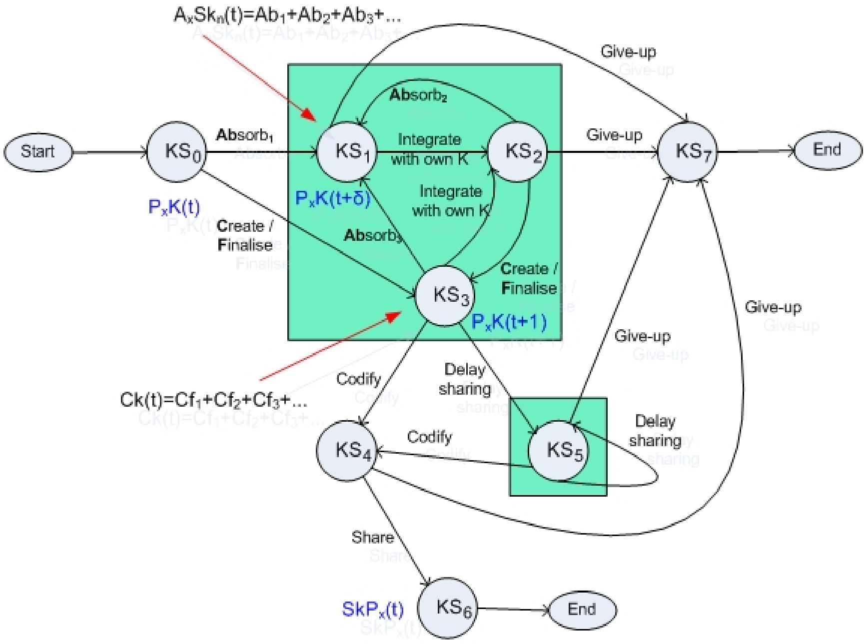



**Figure 3:** Knowledge creation state diagram of an individual

creation state diagram. This analysis and the descriptions based on figure 2 leads into providing a model to quantify knowledge creation and aggregation process mathematically focusing virtual and/or knowledge communities.

The above state diagram with seven knowledge states pictures two exit points where one could share the created knowledge after some means of codifying it or decides to exit out of the process regardless of in which knowledge state that the person engage when such decision is being made. The two knowledge cycles; first, knowledge absorption, integration with their own knowledge, knowledge creation, integration of created knowledge, and finalising the created knowledge ($KS_1$, $KS_2$, $KS_3$); second, the time delay that may be added to the codifying and sharing process if the sharing of created knowledge is not appropriate at that moment ($KS_5$) are highlighted in figure 3. There could be circumstances the knowledge may be codified fully or partially and then one could add the delay for sharing that is not pictured above for simplicity.

The KPLC simplifies knowledge creation, aggregation and sharing aspects of KM within a community knowledge pool and within individuals. The following mathematics (figure 4) shows within an ideal situation that knowledge aggregation over a period of time can be quantified with few assumptions. There may exist terms in (E.g. sub terms in (4) and (5)) equations that are valued to Null as not every moment everyone absorb, create or share knowledge over the considered period. While this quantification does not have a direct influence on the storage space required for the codified knowledge it recognise the patterns immerging in aggregation of knowledge in both cases. This will allow further analysis, perceptive and quantification of knowledge creation and management activities in knowledge communities.

## 4 OPPORTUNITY FOR KNOWLEDGE SHARING WITHIN A COMMUNITY

### 4.1 Formal vs Informal

There are both formal and informal; activities, events, or tools available for individuals to react in order to share knowledge. Communities and groups can organise training programs, workshops, etc and also offer methods, systems and tools for the facilitation of knowledge sharing through formal interactions [25]. Communities can organise formal settings for very large number of audience where the knowledge sharing and dissemination can be speedier and effective. On the other hand interactions of a personal nature, social networks, etc also facilitate the same through informal interactions. While formal settings play an important role of knowledge sharing research has shown most sharing take place under informal settings [8]. The ability to build trust with face-to-face interactions influenced sharing in some cases.

Codifying (for sharing) the knowledge associated with formal activities is somewhat easier based on their structured approach throughout the process. Hence recognition of the type of activity at very early stage can enhance supporting and facilitating KM associated with them. In detail analysis of attributes of formal and informal activities (and/or events) shows that some activities do not clearly fit in with these two types. These specific activities in question have characteristics of informal and some characteristics of formal nature (vice versa) making it difficult to isolate its type. Inherently most activities performed by CoP are informal nature. Similarly Knowledge Networks (KN) perform activities with characteristics that are more formal nature of which some activities also prove to have informal attributes. Hence categorising these activities as ‘formal’ is not appropriate in considering their codifiability. It has been difficult to codify knowledge when the associated activity has more informal nature and therefore to facilitate reusing it. This is also partially due to lack of suitable and standard tools for capturing and analysing such knowledge content. For further analysis of knowledge sharing associated with this mix folded type of activities a third type called ‘nominal’ is defined. In another words nominal activity shows informal as well as formal characteristics. Therefore such recognition has assisted us in improving the process of KM associated with the type of activity or event held by the community. As a result three types of knowledge creation activities are considered in the KM framework defined.

### 4.2 Knowledge Processing, Codification And Reuse Model

The four factors have been identified; nature of knowledge, motivation to share, opportunities to share and culture within work environment as interconnected influencing factors of knowledge sharing [8]. However within a large virtual community environment the culture becomes a very complex matter to discuss, and even between each community group the culture may vary a lot. On the other hand factors such as codifying, storage, access control, estimating the appropriate time for sharing and means of sharing are also valued factors within a complete knowledge creation and management cycle.

An individual may bring new knowledge into the community through external activities, created by working together with others or perhaps by their own work and also via other conduct. Regardless of the origin the individuals’ or knowledge creation groups

$Total\ number\ of\ people\ use\ the\ shared\ pool = n; (Person\ x) = P_x;$

$Knowledge\ shared\ by\ Person\ x\ to\ the\ pool = Sk\ P_x;$

$Knowledge\ shared\ by\ n\ persons\ to\ the\ pool = Sk_n;$

$At\ a\ given\ time\ t, shared\ knowledge\ of\ n\ persons\ can\ be\ written\ as;$

$$Sk_n(t) = Sk\ P_1(t) + Sk\ P_2(t) + .. + Sk\ P_x(t) + .. + Sk\ P_n(t) \quad (1)$$

$Be\ original\ knowledge\ status\ of\ Person\ x, at\ time\ t = P_xK(t);$

$Knowledge\ Absorpsion\ from\ the\ Pool\ (Sk_n)\ by\ Person\ x, at\ time\ t = A_x\ Sk_n(t);$

$\delta = time\ in\ between\ two\ knowledge\ states\ (to\ reach\ at\ KS_1 : fig 3);$

$Be\ aggregated\ knowledge\ of\ Person\ x\ reached\ at\ KS_1\ (fig 3) = P_xK(t+\delta);$

$At\ time\ t+\delta,\ aggregated\ new\ knowledge\ of\ Person\ x\ can\ be\ written\ as;$

$$P_xK(t+\delta) = P_xK(t) + A_x Sk_n(t) \quad (2)$$

$At\ just\ after\ time\ t+\delta, due\ to\ P_xK(t+\delta)\ be\ created\ new\ knowledge = Ck(t+\delta);$

$If\ Person's\ knowledge\ has\ moved\ to\ the\ next\ state\ when\ \delta \to \Delta\ (e.g.\ to\ reach\ at\ KS_2 : fig 3)$

$At\ time\ t+\Delta,\ Person\ x's\ new\ knowledge\ status = P_xK(t+\Delta);$

$$P_xK(t+\Delta) = P_xK(t+\delta) + Ck(t+\delta) \quad (3)$$

$Applying\ (2)\ in\ (3)\ and\ with\ the\ notation\ \Sigma,$

$Combined\ aggregated\ knowledge\ of\ an\ individual\ over\ a\ period\ can\ be\ stated\ as\ below;$

$Be\ person\ x's\ aggregated\ knowledge\ over\ a\ period\ (time\ 0\ to\ t) = P_xk_t;$

$$P_xk_t = \sum_{t=0}^{t=t} P_xK(t+\Delta) = \sum_{t=0}^{t=t} P_xK(t) + \sum_{t=0}^{t=t} A_x Sk_n(t) + \sum_{t=0}^{t=t} Ck(t+\delta) \quad (4)$$

$Also\ from\ above\ (1)\ and\ with\ the\ notation\ \Sigma,$

$Combined\ aggregated\ knowledge\ in\ the\ Pool\ over\ a\ period\ (time\ 0\ to\ t);$

$$Sk_n = \sum_{t=0}^{t=t} Sk_n(t) = \sum_{t=0}^{t=t} Sk\ P_1(t) + \sum_{t=0}^{t=t} Sk\ P_2(t) + .. + \sum_{t=0}^{t=t} Sk\ P_n(t) \quad (5)$$

$$or\ Sk_n = \sum_{t=0}^{t=t} \left( \sum_{x=1}^{x=n} Sk\ P_x(t) \right)$$

**Figure 4:** Knowledge aggregation algorithm for *n* people facilitating a community K pool

must realise the nature of knowledge including its suitability (content, time, etc.) for sharing prior to making the decision of codification and storage. When the knowledge is stored the storage mechanism deals with the availability of the knowledge and the individuals' access rights for that piece of knowledge. Role or process based access control system within the KMI are to provide the required trust and confidence for knowledge owners and for the community in general.

While the community in practice must bring forward opportunities to share knowledge, it must also create a culture for individuals and groups to become motivated for such work. It has been identified that certain aspects of community culture to influence knowledge sharing [26] or vice versa. The community should organise various events on a regular basis that promotes such a motivating environment. The virtual communities should invest and maintain a suitable KMI so that dispersed knowledge creation groups can attain the required benefits of such a system. The ICT tools provided by KMI should support the community for easy management of codified knowledge objects, opportunity for knowledge creation and integration, access control and ownership, timing of sharing, and discarding. A knowledge processing, codification and reuse model (figure 5) has derived that has taken into consideration, most of the above factors. Further details of this model, embedded KMI, and systems usability are to be published in the future.

## 5 FURTHER DEVELOPMENTS

The established prototype with enhanced collaborative development environment facilitates KCP within virtual groups. This prototype is created for gathering user needs and requirements of the targeted communities while providing many

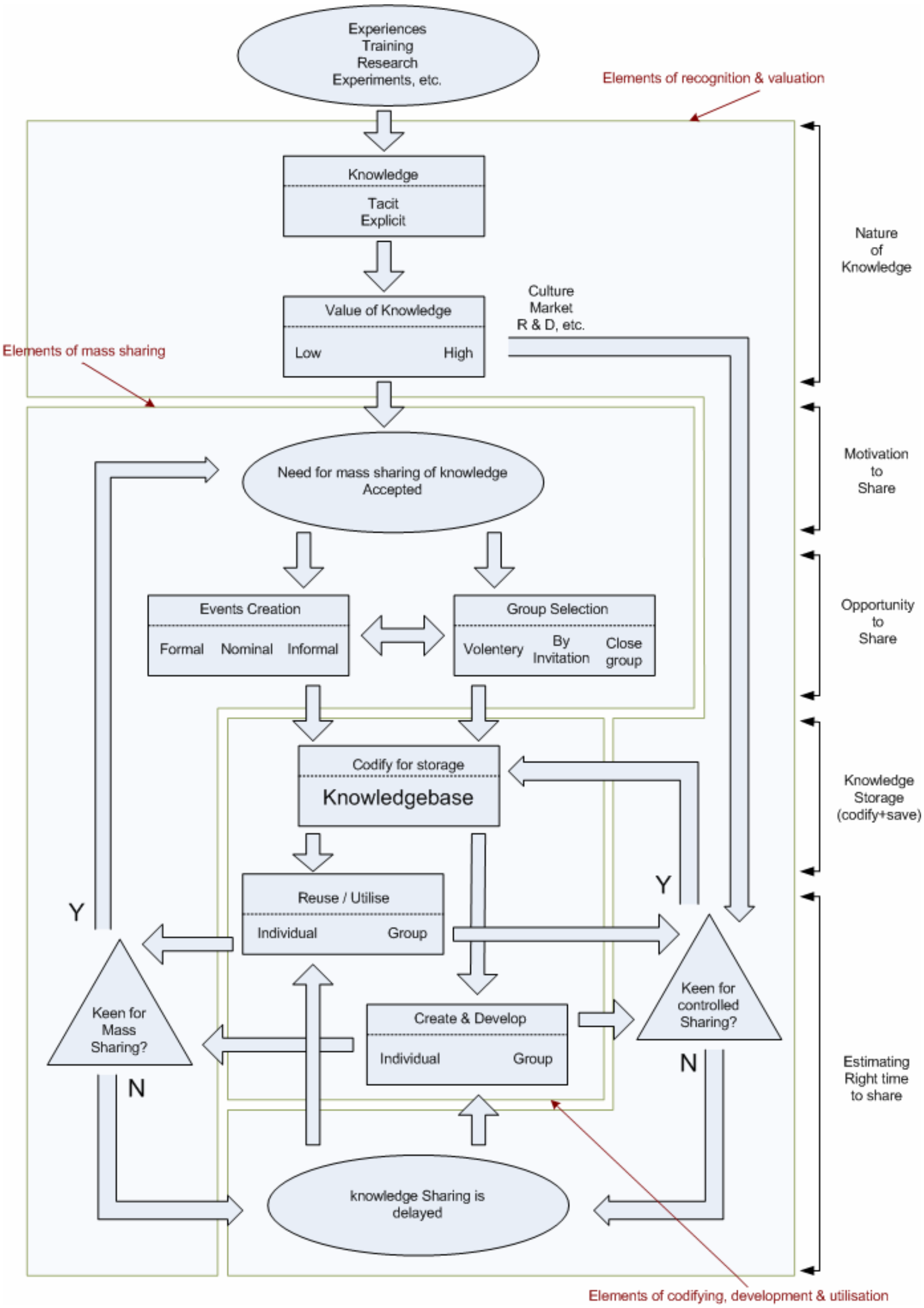



**Figure 5:** Knowledge processing, codification and reuse model

Knowledge Operation (KO) and manipulation tools [27] for daily use. The future developments that embed newly identified user needs which are suitable for integration within this system to be integrated following some extent similar to the 'prototyping' systems development life cycle. Each consecutive prototype version to be used lively within communities for user needs analysis and consensus gathering process which inputs to the next iteration.

### 5.1 Integration of Virtual Machine Architecture With KMI

The implementation of these system prototypes are currently in operation within a virtual machine environment [28]. This facilitates hardware and operating system independence giving the possibility of advanced replication of the repositories [29] and KM operations. To capitalise on the best practices of the virtual infrastructure development, the Virtual Machine Architecture (VMA) services are based on the current technologies that are at enterprise grade. Therefore some of our ongoing work utilises; Jboss

JEMS, WMware Infrastructure 3, Citrix XenServer v4, Internet2, etc, e-science core programme associated services and the latest research (E.g. EU and international developments) which are to be combined to provide an enhanced and consolidated infrastructure for identifying the outlook for future standardisation of community workspace environments. A conceptual diagram of the VMA established for one of the prototypes is shown in figure 6. The current engagement of virtual communities through various projects provide the community base and the user requirements for this research activities, which has become the initial test bed with direct access to many organisations. While the considered KMI provides an essential solution to existing as well as future needs and requirements of these networks of communities the establishment of future research and its sustainability becomes extremely hopeful.

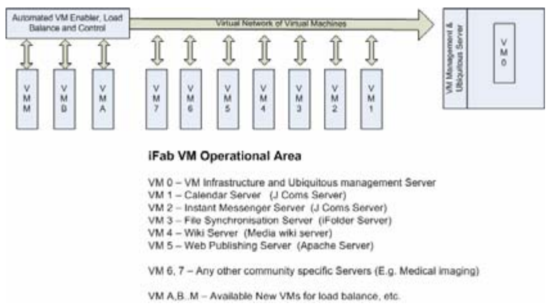



**Figure 6:** Conceptual VM architecture

The integration of final KMI and the VMA within Future Workspaces [30] are also to be discussed in other publications. These future solutions will eliminate complicated physical networking of many computers which facilitates the above ubiquitous environment somewhat similar to figure 6. This technology is to provide very effective and improved systems user response that could otherwise cause an adverse effect. Such infrastructure within Future Workspaces will provide advanced features of KM that are required for successful collaborative knowledge development work among dispersed scientific and professional community groups.

## 6 CONCLUSION

As this paper explores the concept that whilst knowledge sharing is a complex matter to analyse within communities of practice, by adhering to a suitable knowledge management infrastructure and associated tools, some of the complexities recognised can be avoided and appropriate influencing factors of knowledge sharing can be facilitated. Authors have taken the lead in demonstrating this stance by implementing a suitable infrastructure within appropriate settings that captures the user needs and constraints of targeted communities (E.g. [18],[31]). The system has been used by individuals' within virtual communities who create, share and reuse knowledge on a daily basis for various activities that are focused in achieving the goals and objectives of their community. The iterative results, findings and further development work are to be published in the future.

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