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## The knowledge side of the web

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# **The Knowledge Side Of The Web**

**Max Kudrenko**

A dissertation submitted in partial fulfilment of the requirements of  
Dublin Institute of Technology for the degree of  
M.Sc. in Computing (Knowledge Management)

**March 2008**

I certify that this dissertation which I now submit for examination for the award of MSc in Computing (Knowledge Management), is entirely my own work and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the text of my work.

This dissertation was prepared according to the regulations for postgraduate study of the Dublin Institute of Technology and has not been submitted in whole or part for an award in any other Institute or University.

The work reported on in this dissertation conforms to the principles and requirements of the Institute's guidelines for ethics in research.

***Signed:*** \_\_\_\_\_

***Date:***                    ***31 March 2008***

## ABSTRACT

The World Wide Web has become a household name long before its official sixteenth birthday last August (2007), not lastly because of its Knowledge potential encompassed in its vast Knowledge resources and its suitability for Knowledge activities. Out of the three main types of Web usage, which are Procedural, Leisure and Knowledge, this work will concentrate on the Knowledge one and try to analyse the rationale behind its growing popularity among both producers and consumers of Web content.

The extensive Knowledge usage of the Web both demands and offers a specific type of Knowledge, Web Knowledge, which will be assessed and contrasted with its other, more traditional forms, namely, librarian, educational, or organisational Knowledge.

By investigating the Knowledge aspect of the Web, this research will attempt to recognise the key characteristics describing a typical Web Knowledge node. These characteristics will be developed into a framework that will be used to examine a range of different Web sites for the purpose of identifying their Knowledge component.

Ultimately, this work will present a Knowledge view of the Web covering the times of its conception, its current state and its future trends. The objective is to demonstrate that the World Wide Web, despite its liberal and spontaneous nature, is a very fertile ground for the Knowledge and Knowledge Management activities.

**Key words:** *World Wide Web, Web Knowledge, Knowledge activities, Knowledge framework, Knowledge processes, Knowledge forms, Knowledge Management*

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I thank all who care.

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# 1 INTRODUCTION

*“The beginning of knowledge is the discovery of something we do not understand.”*  
Frank Herbert

## ***1.1 Background***

Knowledge itself and desire to Knowledge have always been major drivers of progress that often culminated in many indispensable innovations. It can be argued that one of such essentials today is the Internet with its World Wide Web subsystem commanding the most popularity and attention (Plant, R., 2004; Russell, A.L., 2006; Weaver, A.C., 1998).

More recently, in addition to being one of the main reasons of progress, Knowledge has also become one of its fundamental products. And it is hardly coincidental that when the Internet emerged as one of the best media for today’s business and social activities, the Web became the chosen medium for Knowledge-intensive operations (Eklundh, K.S., et al., 2001; Gaines B., Shaw, M., 1997; Hameri, A.-P., Puitinen, R., 2003). The World Wide Web might not be the winner in such criteria as speed, scope, liberalism or reliability individually but when assessed against them all combined it appears to be the best environment for conducting, among others, such Knowledge Management processes as Knowledge creation, sharing or usage (Eklundh, K.S., et al., 2002).

The main functions the Internet serves today can be classified as being:

- *Information Environment* (Web and Newsgroups);
- *Data Environment* (File Transfer and Streaming);
- *Communication Environment* (Email, Instant Messaging and IP-based Applications).

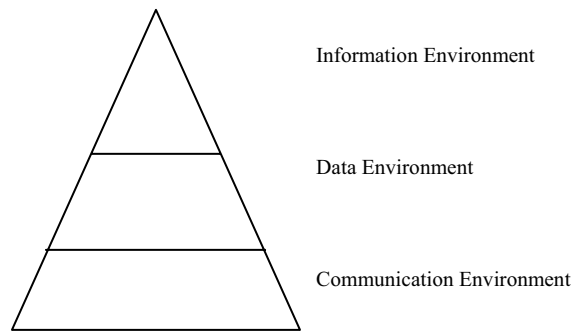


Figure 1.1 Internet functional pyramid

These environments can be seen as the Internet functional pyramid because they are stacked on each other with the Communication Environment at the basic level followed by the Data Environment and topped by the Information Environment. This is somehow similar to the Technology Assessment Model for Knowledge Management where the three top layers (End-User Application Layer, Middleware Layer and Knowledge Repository Layer) correspond to the Information Environment and the last two, Enterprise Data Source Layer and Communication Systems Layer designate the Data and Communication Environments, respectively (Gupta, J., Sharma, S., 2004).

The Communication Environment is fundamental because the Internet is first of all a publicly accessible series of interconnected computer networks that can communicate with each other using the standard set of protocols (Berners-Lee, T., 2007; Potosky, D., 2006). Data Environment is the next level up and is crucial where communicating via the plain text is not enough allowing for transferring data either in discrete chunks (files) or continuous flows (streams). Information Environment's main purpose is in providing the presentation layer to both Communication Environment and Data Environment (Todd, S., 1999). Being the closest to the human among the three and possessing the interface designed specifically for the human, Information Environment serves as a tap opening the conduit of the Internet assets for the human consumption and this is exactly why it is so important from the Knowledge point of view (Eklundh, K.S., et al., 2002; Figallo, C., Rhine, N., 2002). The Internet functional pyramid represents a practical view of the Internet and is not based on implementational models, e.g., TCP/IP or OSI (Russell, A.L., 2006).

Even though there is no distinct border between these environments and they routinely overlap, this work will assume operating only on the subset of the first one, namely the World Wide Web. It took slightly more than a decade for the WWW to become a household name and the main reasons for this are in its ability to serve answers (Knowledge activities), transactions (Procedural activities) and fun (Leisure activities). Therefore, Knowledge, Procedural and Leisure sites are the three types of Web resources examined here.

Similarly to the Internet functional pyramid, there is also the Knowledge pyramid with Data, Information, Knowledge and, sometimes, Wisdom as its building blocks (Hey, J., 2004; Rowley, J., 2006; Stankosky, M., 2005). Since Knowledge is a level up the pyramid above Information or, in other words, is based and dependent on Information, if there is such a thing as Knowledge Environment, most likely it is also to be relying and operating on Information Environment. Out of the two main components of Information Environment, the WWW and Newsgroups, the first is by far the most popular, in general, and suitable for more Knowledge activities, in particular, so only the World Wide Web is examined here and the context is that it is the sought Knowledge Environment.

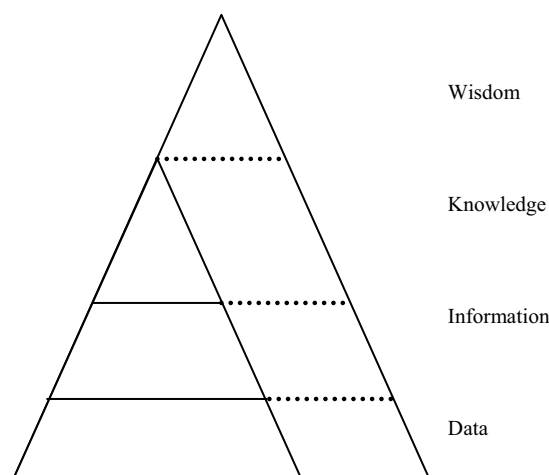


Figure 1.2 Knowledge pyramid

The two pyramids have several similarities with Data predominantly residing in Data Environment and Information found in Information Environment. Knowledge, however, does not have a direct counterpart in the Internet functional pyramid and so, together with Wisdom, they form abstract layers above Information Environment.

This work concentrates on the Knowledge link only since there is still no consensus whether Wisdom should be included in the Knowledge pyramid or not (Rowley, J., 2006). Knowledge Environment is largely abstract because, technically, it is operating on the same set or resources and technologies as Information Environment. Advances in Web research, however, may make it a real layer in the Internet functional pyramid, especially when the Semantic Web concept gains more momentum and technological support.

It is also worth noting that the current perception of Knowledge among the public is rather vaguely defined. If even the experienced Knowledge practitioners can not always find the common ground regarding definitions of Knowledge and its differences to Information (Gottschalk, P., 2005; Holsapple, C.W., Joshi, K.D., 2002; Stankosky, M., 2005), it must be forgiven that the general Web audience can treat Knowledge and Information interchangeably so for the purpose of this research these entities will be classified as belonging to the Knowledge category of Web activities. After all, Knowledge can be said to simply be actionable Information (Tiwana, A., 1999) or Information in the human minds (Gottschalk, P., 2005).

## ***1.2 Motivation***

It is estimated that there is more than a billion of Internet users worldwide which means that roughly every fifth person in the world is using some of the Internet services. A separate data for the Web usage is not widely available but it can be estimated in the same region because the results count people going online which automatically implies the World Wide Web rather than other Internet subsystems.

So why are all these masses want online? How much time are they spending there and how they are spending it? What are they doing there? Are they just killing their time or doing something meaningful? Are they learning something useful on the Web or only degrading lost in virtual space? Trying to answer these types of questions was the original reason for this research because dependency on the Web bring concerns as well as stimuli to address those concerns.

Apparently, Web usage varies and one way of classifying it is by the type of activities done online. These can be split into three big categories, Procedural, Leisure and Knowledge activities, and the other driving force behind this work was to look at them and attempt to explain the importance of the Knowledge factor for an average Web user.

Knowledge-conscious Web users go online not only to conduct some activities but also to use some resources or, in other words, they need a Knowledge environment. The World Wide Web appears to be a fertile ground for such an environment and examining what characteristics are vital for a Web site to be seen by the online community as a Knowledge node was another determinant for this study.

The last motive was in trying to see a social, unregulated and informal side of Knowledge Management which was largely missing from the mainstream literature but is inherently present in the World Wide Web. If the Web is a Knowledge environment, it is interesting to examine what Knowledge exists there and how it can be managed for the maximum benefit of the users.

### ***1.3 Objectives***

The objective of this research is to investigate the Knowledge aspect of the World Wide Web by comparing and contrasting Web Knowledge with its other forms, e.g., librarian, educational, or organisational Knowledge. This investigation should provide information as to what attributes are essential to make a site Knowledge-relevant and those attributes will serve as a basis for devising the evaluation rubric. This rubric, or framework, is going to be used to assess the Knowledge constituent of a selection of Web resources.

The first objective here is to conduct an in-depth research of Knowledge Web resources, in particular, with respect to how they are defined by content producers and how they are used by content consumers. The other types of Web usage, namely Procedural and Leisure, will be juxtaposed to the Knowledge usage to see their relationships in different contexts. The retrospective analysis of the main drivers

behind the Web's conception as well as the prospective outlook into the future Web developments will also be undertaken.

The second objective is to look at the other forms of public Knowledge and try to explain differences and similarities they have with the Web Knowledge. In addition to the personal Knowledge, which exists in the head of its owner, Knowledge is also embodied in such public entities as libraries, educational institutions and organisations. More recently, this list expanded to include the Web Knowledge and the explanations of its specifics will be sought.

Development of the Attributive Framework for Assessing Web Knowledge (AFAWK) is the third and main objective of this work. This framework's purpose is in providing reasonable grounds for Web resources classification with regard to their Knowledge relevance and it will be built around a set of attributes and metrics identified during the research. These attributes, or characteristics, will be used to distinguish the sites with Knowledge value from the ones without such and the metrics will help to classify that value.

The last objective is to apply the created framework to a number of Web resources of different orientation including Knowledge sites as well as Procedural or Leisure ones and observe the results. It must be noted here that the rubric will be devised based on the analysis of a collection of Web sites that are deemed to possess certain degree of Knowledge and later some of those sites can again be examined by the way of application of the same rubric. Also, of a particular interest is the experimental Knowledge site built specifically for the purpose of this study.

Due to the elusive nature of Knowledge measurement, both qualitative and quantitative analysis will be used throughout the research in aiding the conception as well as application of the framework.

## ***1.4 Outline***

The next chapter, *State Of The Art*, will look into the background of the Knowledge as it exists in and outside the World Wide Web and how it is reflected in the current literature. General definitions of Knowledge and Knowledge Management will be reviewed and these will be later attempted to be mapped onto the Web context. Existing uncertainties and gaps will be highlighted.

After that, the assessment framework will be devised in the chapter *Framework*. Based on the findings from the previous chapter as well as analysis of certain related Web resources, Attributive Framework for Assessing Web Knowledge (AFAWK) will be constructed. All the attributes comprising the framework will be inspected and for each the feasibility of having appropriate metrics will be considered.

In the chapter *Reality Check*, the users' perception of Knowledge on the Web will be looked into. A range of online surveys will be conducted and the design and usage of the experimental Knowledge site implementing some of the features from the framework will be examined. Also, several case studies will be conducted where a number of popular sites of various classifications will be reviewed against the AFAWK pattern.

In the closing chapter, *Conclusions*, the achievements and observations of this study will be discussed and directions for future work will be suggested.



## 2 STATE OF THE ART

*“Knowledge is the only instrument of production that is not subject to diminishing returns.”*  
John Maurice Clark

### ***2.1 Knowledge Management***

#### *2.1.1 Knowledge*

Knowledge is one of those terms everybody seems to immediately be able to understand while struggling to precisely define or describe (Evers, H-D., 2003; Hicks, R., Dattero, R., Galup. S., 2007; Holsapple, C.W., Joshi, K.D., 2002; Tiwana, A., 1999). Leaving aside linguistic and philosophic interpretations, this work is only concentrating on Knowledge in the Knowledge Management (KM) context where majority of Knowledge definitions are using the Knowledge pyramid or Knowledge hierarchy as one of the supporting axioms for the introduction of the relevant terminology and concepts (Gupta, J., Sharma, S. 2004; Hey, J., 2004; Stankosky, M., 2005). The Knowledge pyramid has Data, Information, Knowledge and, sometimes, Wisdom layered on top of each other where the lower layer feeds the upper one with required resources (Figure 1.2).

Assuming that Data is a collection of raw facts, e.g., measurements, records or statistics, Information can be defined as organised or processed data that is timely and accurate while Knowledge can be described as Information that is contextual, relevant, and actionable (Turban, E., Aronson, J.E., 2000). The agreement that Knowledge must be actionable seems to be widespread so it can be regarded as one of its main characteristics (Gupta, J., Sharma, S. 2004; Hicks, R., Dattero, R., Galup. S., 2007; Rao, M., 2004; Stankosky, M., 2005; Tiwana, A., 1999). What being actionable means is that it helps its consumers to act consciously and, therefore, having Knowledge can be translated into being ready for actions. Another commonly accepted Knowledge feature closely related to actionability is dynamism (Gottschalk, P., 2005; Nonaka, I., Toyama R., Konno, N., 2000; Stankosky, M., 2005). Why Knowledge is dynamic is because, in order to stay relevant and actionable, it must adjust when circumstances and environment or, in other words, the context, change (Evans, Z., 2003).

Regardless of the context, Knowledge invariably requires the human element for its own definition and existence (Fahey, L., et al., 2001; Figallo, C., Rhine, N., 2002; Gottschalk, P., 2005; Tiwana, A., 1999). The human element, or Knower, can be seen as a crucial transformation mechanism because by passing through it Knowledge can be converted from tacit to explicit (two types of Knowledge) or vice versa (Gupta, J., Sharma, S., 2004; Nonaka, I., Toyama R., Konno, N., 2000; Turban, E., Aronson, J.E., 2000). Simply put, tacit Knowledge is internal to the human while explicit Knowledge is externalised in some shape or form (Hicks, R., Dattero, R., Galup. S., 2007; Kille, A., 2006; Waltz, E., 2003).

It is worth mentioning that sometimes Knowledge can be seen as an object as well as a process (Figallo, C., Rhine, N., 2002; Tiwana, A., 1999). This study, however, treats Knowledge as an object or rather a concept and examines Knowledge processes separately. Working off this assumption, it appears that there is no general consensus as to what is necessary or appropriate for the description of Knowledge except for its pyramid, actionability, dynamism, human element and two types (tacit and explicit). Therefore, these characteristics are used in here as declarative for its operational definition (De Judicibus, D., 2008).

#	Knowledge declarative characteristic	Characteristic description
1	Knowledge pyramid	Knowledge is normally considered in the context of the related concepts of Data, Information and, sometimes, Wisdom.
2	Actionability	Knowledge is actionable, i.e., having it helps act consciously or well-groundedly.
3	Dynamism	Knowledge is dynamic, i.e., it is changing as its context changes.
4	Human element	Knowledge needs the human at some stage of its lifecycle.
5	Knowledge type: tacit or explicit	Knowledge is either tacit (internal to the human) or explicit (external to the human).

Table 2.1 Knowledge characteristics

The majority of KM literature considers Knowledge primarily in the organisational context (Gupta, J., Sharma, S., 2004; Nonaka, I., Toyama R., Konno, N., 2000; Rao,

M., 2004; Stankosky, M., 2005). This can be explained by the fact that the main emphasis there is placed on the concept of Knowledge Management rather than the concept of Knowledge itself which is used primarily as a supporting pillar for the KM paradigm (Turban, E., Aronson, J.E., 2000). And since KM implies the multiplicity of Knowledge entities, it naturally translates into the multiplicity of Knowers and, consequently, attains the communal meaning. It is important to note that, even though both the multiplicity of Knowers and the communal meaning can exist in the formal structures, they can equally do so in the informal environments and so both are technically suitable for Knowledge Management (Khe Foon Hew, Hara, N., 2006; Lee, M., et al., 2006; Tiwana, A., 1999). The crucial difference between the formal and informal environments is in the contractual liability which can be used to officially and uniformly enforce any ideology, methodology or initiative, including Knowledge Management. Because the formal structures, or organisations, have this enforcement mechanism, it gives them fuller control over the execution of the KM programme (Gottschalk, P., 2005; Kinga, W.R., Marks P.V.Jr., 2004). Having no such enforcements, however, does not automatically mean that Knowledge and its derivatives, e.g., Knowledge Management can not exist, it only means that they can not be as easily and efficiently controlled but, arguably, the goodwill and freedom can be not less efficient KM drivers (Allen, C., 2004; Nonaka, I., Toyama R., Konno, N., 2000). This work concentrates on one of the most prominent informal environments, which is the World Wide Web, and tries to project the validity of the Knowledge and, to some extent, Knowledge Management concepts in this habitat but the formal views and definitions are also included for the sake of completeness and also because of their dominance in the current KM theory.

In the organisational context, Knowledge broadly refers to all that an organisation needs to know to properly perform its functions. This includes formalised Knowledge such as patents, programs, procedures as well as the more intangible assets, e.g., know-how, skills, and experience of people. It also addresses the work processes, organisational culture and values, internal and external communications and relationships. Knowledge Management, in turn, is about managing all the particulars of Knowledge to create business value and achieve competitive advantage (Gottschalk, P., 2005; Sridharan, B., Tretiakov, A., Kinshuk, 2004; Turban, E., Aronson, J.E., 2000). In other words, Knowledge Management helps to systematically leverage

expertise and Knowledge to enhance effectiveness, facilitate innovation, and improve efficiency and competency (Stankosky, M., 2005). It can also be described as a discipline combining the people, their operations and the information technology to create, share and use Knowledge that allows an organisation to accomplish its mission (Waltz, E., 2003). Despite the existing differences in definitions of Knowledge Management, it is widely accepted that its aim is to establish a structured framework to enable and support three main generic Knowledge-related processes of Knowledge creation, sharing and usage (Fahey, L., et al., 2001; Gottschalk, P., 2005; Gupta, J., Sharma, S., 2004; Turban, E., Aronson, J.E., 2000). Even though the core processes for creating, sharing and using Knowledge are the cornerstones of Knowledge Management and cover a typical KM lifecycle quite well, there also are other KM activities involved either as an independent process on its own or as a part of the bigger one (Fahey, L., et al., 2001). For example, Knowledge identification or capturing are clearly Knowledge creation processes while Knowledge organisation, storage or retrieval are rather autonomous and can be serving several other processes at the same time.

Beyond the organisational context, however, defining Knowledge in the KM scope is very different and, perhaps, more difficult because the multiplicity of Knowers very rarely have much in common except for their individual interests (Lee, M., et al., 2006). In the case of the World Wide Web, in particular, all its uses and users are not governed by any explicit form of rules and so they can be treated as independent of each other (Lu, H., Hsiao, K., 2007; Plant, R., 2004). This may not have a big impact on the definition of Knowledge itself as its main characteristics can translate well from the group to individual context but for Knowledge Management such an environment poses a major impediment as it advocates diversity and freedom over uniformity and control (Kinga, W.R., Marks P.V.Jr., 2004). More importantly, outside the organisational context it is not clear who is the beneficiary of Knowledge Management as the concepts of business value and competitive advantage may not be relevant for many participants of informal communities (Khe Foon Hew, Hara, N., 2006; Lee, M., et al., 2006). Nevertheless, at least partial validity of Knowledge Management in any environment can be shown by demonstrating existence of both Knowledge itself and its three generic processes: Knowledge creation, Knowledge sharing and Knowledge usage.

### 2.1.2 Knowledge Processes

For Knowledge, being dynamic means that it changes and evolves (Huang, H., Liaw, S., 2001; Turban, E., Aronson, J.E., 2000). But its dynamism equally implies the existence of Knowledge processes that themselves effectively define Knowledge Management and, therefore, are also called Knowledge Management processes (Gottschalk, P., 2005; Waltz, E., 2003). Even though the exact terminology and valuation of each of the involved processes may vary, the basic steps are creation, sharing and usage of Knowledge (Nonaka, I., Toyama R., Konno, N., 2000; Sridharan, B., Tretiakov, A., Kinshuk, 2004; Stankosky, M., 2005). It is important to note that Knowledge Management is generally viewed as a cyclic activity and its processes are expected to repeat indefinitely during a KM lifecycle (Evans, Z., 2003; Gottschalk, P., 2005; Gupta, J., Sharma, S., 2004; Turban, E., Aronson, J.E., 2000). All core processes can rely on a mixture of dependent and independent subprocesses. Dependent subprocesses are tightly coupled with their core process and do not normally occur outside their scope whereas independent subprocesses are loosely coupled with core processes and can exist in multiple scopes. Sometimes a dependent subprocess can effectively refer to the same thing as its core process with the only difference being in the terminology, e.g., Create Knowledge and Generate Knowledge or Use Knowledge and Utilise Knowledge. In most cases, however, a dependent subprocess is indeed a distinct entity addressing only a part of the core process.

#	Core process	Dependent subprocess	Independent subprocess
1	Create Knowledge (Gottschalk, P., 2005; Gupta, J., Sharma, S., 2004; Holsapple, C.W., Joshi, K.D., 2002; Nonaka, I., Toyama R., Konno, N., 2000; Rao, M., 2004; Sridharan, B., Tretiakov, A., Kinshuk, 2004; Stankosky, M., 2005; Tiwana, A., 1999; Turban, E., Aronson, J.E., 2000; Waltz, E., 2003)	Acquire (Gottschalk, P., 2005; Gupta, J., Sharma, S., 2004; Holsapple, C.W., Joshi, K.D., 2002; Tiwana, A., 1999; Waltz, E., 2003); Capture (Gottschalk, P., 2005; Gupta, J., Sharma, S., 2004; Holsapple, C.W., Joshi, K.D., 2002; Rao, M., 2004; Turban, E., Aronson, J.E., 2000; Waltz, E., 2003); Codify (Gottschalk, P., 2005; Rao, M., 2004; Stankosky, M., 2005; Waltz, E., 2003); Generate (Gottschalk, P., 2005;	Deliver (Tiwana, A., 1999; Waltz, E., 2003); Discover (Gupta, J., Sharma, S., 2004; Holsapple, C.W., Joshi, K.D., 2002; Rao, M., 2004; Waltz, E., 2003); Maintain (Gupta, J., Sharma, S., 2004; Tiwana, A., 1999; Waltz, E., 2003); Manage (Gupta, J., Sharma, S., 2004; Nonaka, I., Toyama R., Konno, N., 2000; Rao, M., 2004; Turban, E., Aronson, J.E., 2000); Organise (Gottschalk, P., 2005; Gupta, J., Sharma, S., 2004; Tiwana,

		<p>Holsapple, C.W., Joshi, K.D., 2002; Stankosky, M., 2005; Waltz, E., 2003);  <b>Identify</b> (Tiwana, A., 1999; Waltz, E., 2003);  <b>Refine</b> (Gupta, J., Sharma, S., 2004; Holsapple, C.W., Joshi, K.D., 2002; Turban, E., Aronson, J.E., 2000);  <b>Retain</b> (Stankosky, M., 2005; Waltz, E., 2003);  <b>Transform</b> (Holsapple, C.W., Joshi, K.D., 2002; Tiwana, A., 1999; Waltz, E., 2003);</p>	<p>A., 1999; Waltz, E., 2003);  <b>Retrieve</b> (Gottschalk, P., 2005; Gupta, J., Sharma, S., 2004; Holsapple, C.W., Joshi, K.D., 2002; Rao, M., 2004);  <b>Store</b> (Gottschalk, P., 2005; Gupta, J., Sharma, S., 2004; Tiwana, A., 1999; Turban, E., Aronson, J.E., 2000);</p>
2	<p><b>Share Knowledge</b>  (Gupta, J., Sharma, S., 2004; Holsapple, C.W., Joshi, K.D., 2002; Rao, M., 2004; Sridharan, B., Tretiakov, A., Kinshuk, 2004; Turban, E., Aronson, J.E., 2000; Waltz, E., 2003)</p>	<p><b>Exchange</b> (Figallo, C., Rhine, N., 2002; Waltz, E., 2003);  <b>Transfer</b> (Gottschalk, P., 2005; Gupta, J., Sharma, S. 2004; Holsapple, C.W., Joshi, K.D., 2002; Stankosky, M., 2005; Waltz, E., 2003);  <b>Disseminate</b> (Holsapple, C.W., Joshi, K.D., 2002; Turban, E., Aronson, J.E., 2000; Waltz, E., 2003);  <b>Distribute</b> (Gupta, J., Sharma, S., 2004; Holsapple, C.W., Joshi, K.D., 2002; Rao, M., 2004; Tiwana, A., 1999);</p>	<p><b>Deliver</b> (Tiwana, A., 1999; Waltz, E., 2003);  <b>Maintain</b> (Gupta, J., Sharma, S., 2004; Tiwana, A., 1999; Waltz, E., 2003);  <b>Manage</b> (Gupta, J., Sharma, S., 2004; Nonaka, I., Toyama R., Konno, N., 2000; Rao, M., 2004; Turban, E., Aronson, J.E., 2000);  <b>Organise</b> (Gottschalk, P., 2005; Gupta, J., Sharma, S., 2004; Tiwana, A., 1999; Waltz, E., 2003);  <b>Retrieve</b> (Gottschalk, P., 2005; Gupta, J., Sharma, S., 2004; Holsapple, C.W., Joshi, K.D., 2002; Rao, M., 2004);  <b>Store</b> (Gottschalk, P., 2005; Gupta, J., Sharma, S., 2004; Tiwana, A., 1999;; Turban, E., Aronson, J.E., 2000);</p>
3	<p><b>Use Knowledge</b>  (Gottschalk, P., 2005; Holsapple, C.W., Joshi, K.D., 2002; Rao, M., 2004; Sridharan, B., Tretiakov, A., Kinshuk, 2004; Stankosky, M., 2005; Waltz, E., 2003)</p>	<p><b>Apply</b> (Gottschalk, P., 2005; Rao, M., 2004; Gupta, J., Sharma, S. 2004; Tiwana, A., 1999);  <b>Leverage</b> (Gottschalk, P., 2005; Rao, M., 2004; Waltz, E., 2003);  <b>Reuse</b> (Rao, M., 2004; Tiwana, A., 1999; Waltz, E., 2003);  <b>Utilise</b> (Gupta, J., Sharma, S. 2004; Rao, M., 2004; Stankosky, M., 2005)</p>	<p><b>Deliver</b> (Tiwana, A., 1999; Waltz, E., 2003);  <b>Discover</b> (Gupta, J., Sharma, S., 2004; Holsapple, C.W., Joshi, K.D., 2002; Rao, M., 2004; Waltz, E., 2003);  <b>Maintain</b> (Gupta, J., Sharma, S., 2004; Tiwana, A., 1999; Waltz, E., 2003);  <b>Retrieve</b> (Gottschalk, P., 2005; Gupta, J., Sharma, S., 2004; Holsapple, C.W., Joshi, K.D., 2002; Rao, M., 2004);  <b>Store</b> (Gottschalk, P., 2005; Gupta, J., Sharma, S., 2004; Tiwana, A., 1999;; Turban, E., Aronson, J.E., 2000);</p>

Table 2.2 Knowledge processes

The first core process is about creating Knowledge and its importance is difficult to overestimate (Huang, H., Liaw, S., 2001; Nonaka, I., Toyama R., Konno, N., 2000; Stenmark, D., 2003). It can be argued that it is the most difficult process in the KM lifecycle because creating a product is generally more time and effort consuming than distributing or using it and judging by the multiplicity of related subprocesses it can also be deemed one of the most complicated. Its most commonly known dependent subprocesses are Acquire, Capture, Codify, Generate, Identify, Refine, Retain and Transform while independent subprocesses can include Deliver, Discover, Maintain, Manage, Organise, Retrieve and Store Knowledge. Another potential problem here is that creating such subtle products as Knowledge is always challenging. Why this process is so important is because it is an entry point into the whole KM domain and is largely responsible for setting its scope, requirements and standards (Gupta, J., Sharma, S., 2004). This is the only process that normally requires for its proper initialisation direct or indirect participation of tacit Knowledge. People involved in creating Knowledge can be described as Knowledge producers.

The second core process is Knowledge sharing which effectively makes Knowledge available to those who need it (Hicks, R., Dattero, R., Galup. S., 2007). The first difficulty here is in motivation as sharing something valuable can be often seen as losing its value so it may require certain cultural changes or mental shifts (Gottschalk, P., 2005; Kinga, W.R., Marks P.V.Jr., 2004; Stenmark, D., 2003). It is important to note here that, unlike most other resources, Knowledge is not diminishing when shared, it is rather growing as what was known by one before is known by many after and so the Knowledge quantity is increased (Gottschalk, P., 2005; Turban, E., Aronson, J.E., 2000). The other major issue with Knowledge sharing is targeting or linking interested parties with relevant resources, especially when either increases in magnitude (Hicks, R., Dattero, R., Galup. S., 2007). Exchange, Transfer, Disseminate and Distribute Knowledge are its main dependent subprocesses and Deliver, Maintain, Manage, Organise, Retrieve and Store Knowledge are some of its independent subprocesses. Both Knowledge producers and Knowledge consumers can participate in sharing Knowledge with more active participation expected from Knowledge producers.

Knowledge usage is the last core process in a KM lifecycle and it is the obvious culmination of most KM initiatives as Knowledge benefits manifest themselves in the application of Knowledge rather than in Knowledge itself (Gottschalk, P., 2005; Turban, E., Aronson, J.E., 2000). As its dependent subprocesses Knowledge usage includes Apply, Leverage, Reuse and Utilise Knowledge and since they all in essence denote the same thing, it can be said that there are no direct dependencies for this core process. Its indirect dependencies, or independent subprocesses, are traditional: Deliver, Discover, Maintain, Retrieve and Store Knowledge. Naturally, using Knowledge is done by users, or Knowledge consumers.

All core processes are supported by almost the same set of independent subprocesses, which is not surprising taking into account that those subprocesses have technical rather semantic relationship to the KM domain. Here, most of them are insignificant from the point of view of Knowledge Management because they, generally, exclude the human element and operate on a lower level (Turban, E., Aronson, J.E., 2000). These subprocesses can be seen as some sort of a file system or database mechanism manipulating data or information rather than Knowledge (Gottschalk, P., 2005; Herder, P.M., et al., 2003). Dependent subprocesses, on the other hand, most of the time work directly on Knowledge and, therefore, have the human element involved. The main attention, however, here is upon the three core processes that are largely responsible for defining both Knowledge Management itself and Knowledge side of the Web.

It is important to note that Nonaka's SECI (socialisation, externalisation, combination, internalisation) framework can also feed Knowledge sharing and usage processes in addition to the creation one which it was specifically designed for (Nonaka, I., Toyama R., Konno, N., 2000). This is partly due to the fact that Knowledge creation is perhaps the most fundamental process that inherently present in all the Knowledge activities but partly it is because this framework appears to be so comprehensive that it can indeed cover most of such activities quite well. After all, each of the core Knowledge processes operates on either tacit or explicit Knowledge and the SECI rubric supports every possible scenario when these two types come into contact. Therefore, the SECI cycle can be used to describe all the three processes.



### *2.1.3 Knowledge Forms*

Traditionally, the main forms, or sources, of public Knowledge were librarian, educational, and organisational. This implies that libraries, educational institutions and organisations are the places where Knowledge can exist relatively autonomously of external influences and these are the places where people would normally look for Knowledge (Figallo, C., Rhine, N., 2002). The librarian Knowledge is completely explicit as it is obtained from the explicit sources while the educational and organisational forms thrive on mainly tacit Knowledge. The human element and, thus, the tacit component of the librarian Knowledge can be ignored because the library staff does not necessarily possess any Knowledge value and are not mandatory for any Knowledge process conducted in a library. The explicit component of the educational and organisational Knowledge, on the other hand, is always quite significant and at times it can be absolutely crucial. Often, most critical and relevant Knowledge in both educational institutions and organisations is tacit and resides in their Knowledge workers (Turban, E., Aronson, J.E., 2000). This Knowledge is actionable and it is normally most important at any given point in time (Gottschalk, P., 2005). But there can also be a lot of explicit externalised Knowledge in such environments (Turban, E., Aronson, J.E., 2000). This Knowledge is dormant because it is not immediately required or available but its overall volume may well exceed that of the tacit, actionable one.

The library of Alexandria, founded at the beginning of the third century BC and dubbed the first Knowledge centre, helped many significant advances in philosophy and the sciences (Dobson, T., Willinsky, J., 2007; Figallo, C., Rhine, N., 2002). Ever since then, libraries have been instrumental in cherishing and promoting progress in all walks of life. It is difficult to argue that books are the best specimen of explicit Knowledge and libraries are traditionally the first place to get a book (Khe Foon Hew, Hara, N., 2006; Rao, M., 2004). Even though first libraries had tablets and scripts rather than books, with time, books became the main element of the librarian Knowledge, complemented with letters, records, maps, print media and other tangible forms of information (Bergeron, B., 2003). Recently, librarian horizons expanded as libraries started to house information in both tangible and intangible forms, some even went as far as converting their repositories into digital format and putting them online

(Drexler, E.K., 1995; Figallo, C., Rhine, N., 2002; Kille, A., 2006; Weaver, A.C., 1998). Another aspect of libraries is in providing not only storage but also structuring and lookup arrangements for all the kept information. This is exactly where the library staff comes into play as some of their main responsibilities are to keep the repositories well-structured and know the shortcuts to the required information (Turban, E., Aronson, J.E., 2000). These library staff are the human element bringing the tacitness to the librarian Knowledge but their semantic weight in the KM context, similarly to the role of storage/retrieval processes in a KM lifecycle, is reasonably low (Kille, A., 2006; Tiwana, A., 1999). It is valid, therefore, to treat the librarian Knowledge as completely explicit and dormant (Bergeron, B., 2003).

The educational Knowledge is even older than the librarian Knowledge with its roots traced back to Ancient Egypt and Israel. While the exact timing of appearance of first educational institutions remains unknown, the formalisation of educational Knowledge can be attributed to the foundation of pedagogy in Ancient Greece with the names of Socrates, Plato, and Aristotle being the main educational proponents (Figallo, C., Rhine, N., 2002). Ironically enough, Socrates, who is credited with being one of the fathers of epistemology, or theory of Knowledge, is also well known for his equivocal “All I know is I know nothing”. The relationship between the education and Knowledge is obvious as the education creates Knowledge so it is the Create Knowledge process but it is also valid to say that Knowledge feeds the education (Gottschalk, P., 2005; Rao, M., 2004; Turban, E., Aronson, J.E., 2000). As a source of Knowledge, educational institutions exhibit it primarily with their teaching staff in the tacit form (Gupta, J., Sharma, S., 2004; Huang, H., Liaw, S., 2001). The explicit form is inherently present, too, as any education relies on books but its importance is secondary to the human element with notions of passion, vocation, ken, vigour, spirituality and altruism being main driving forces behind a proper educational process (Gottschalk, P., 2005; Rowley, J., 2006; Turban, E., Aronson, J.E., 2000). Without the human contribution, the educational Knowledge is not much different from the librarian Knowledge, especially taking into account that the vast majority of educational institutions have in-house libraries and depend on their resources in their day-to-day operations (Kille, A., 2006). Mentorship, counselling, acumen, enthusiasm and tacit Knowledge of the teaching staff is what sets the educational institutions apart from the libraries but in the end, the educational Knowledge is only potentially

beneficial because neither the Knowledge producers nor Knowledge consumers can use it for an immediate profit (Chang, Chi-Cheng, 2003; Chiles, A., 2008; Gupta, J., Sharma, S., 2004).

As opposed to the first two forms of public Knowledge that generally exist to serve the outside world, the organisational Knowledge is rather introvert by definition. While the librarian and educational Knowledge are devised to be taken away from its home, the organisational Knowledge is meant to stay in its birthplace. Even though in some cases where the headcount is in single figures the organisational Knowledge can be personal or private, for most organisations it is public due to the number of employees involved (Kinga, W.R., Marks P.V.Jr., 2004). Therefore, its public nature is determined by the multiplicity of inside Knowers, i.e., the employees. On the other hand, it is supposed to be private or proprietary from the point of view of the outsiders simply because the organisational Knowledge is a precious asset that may lose its value once exposed (Turban, E., Aronson, J.E., 2000). It may be against one of the core KM principles that state that Knowledge is only replenished when shared but in the organisational context, in general, and market conditions, in particular, all KM processes and initiatives are normally only projected within the boundaries of the organisation. Most organisations have some form of external competition and since the organisational Knowledge is one of the main factors that help them to achieve the competitive advantage and accomplish their mission better than others, it is natural that they protect it (Gottschalk, P., 2005; Lee, M., et al., 2006; Stenmark, D., 2003; Turban, E., Aronson, J.E., 2000).

As previously mentioned, the organisational Knowledge broadly refers to all that an organisation needs to know to properly perform its functions, including tangible and intangible assets, work processes, culture and values as well as skills and experience of its people. The organisational Knowledge cannot be dissociated from the organisational context in which it is created and used (Gupta, J., Sharma, S., 2004; Hameri, A.-P., Puittinen, R., 2003; Nonaka, I., Toyama R., Konno, N., 2000). Sometimes, the organisational Knowledge can also refer to the intellectual capital or organisational memory (Gottschalk, P., 2005; Turban, E., Aronson, J.E., 2000). Historically, the tacit component was dominant and despite the recent advances in the document workflow and database management systems it still remains prevailing in

many modern companies (Elenurm, T., 2004; Erickson, T., Kellogg, W.A., 2001; Evans, Z., 2003). Actually, externalisation of tacit Knowledge is one of the main goals of the majority of KM initiatives but it is always difficult to fully implement due to various reasons as people might not be willing or simply able to properly externalise their Knowledge, which thereby remains permanently tacit (Gupta, J., Sharma, S., 2004; Gottschalk, P., 2005; Kinga, W.R., Marks P.V.Jr., 2004). Whether tacit or explicit, ultimately the organisational Knowledge is aimed at helping the organisations to achieve their goals and, therefore, it is tangibly beneficial (Bergeron, B., 2003; Evans, Z., 2003; Herder, P.M., et al., 2003; Turban, E., Aronson, J.E., 2000).

It can be seen that these forms of Knowledge are not mutually exclusive and their relationship can be likened to a known pyramid structure with its blocks in reverse order. The bottom block is the librarian, followed by the educational with the organisational Knowledge on top. Since the blocks are in reverse to natural pyramidal order, the bottom one has the narrow end while the top is the widest block. This upside-down pyramid demonstrates that the librarian Knowledge is the most granular entity and blocks stacked above it can and normally do use its resources. It can be said that the librarian Knowledge feeds both the educational and the organisational Knowledge layers (Kille, A., 2006). The educational Knowledge, in turn, can feed the organisational layer as more and more organisations implement some sort of competency control and improvement programmes (Elenurm, T., 2004; Fahey, L., et al., 2001; Gupta, J., Sharma, S., 2004). Also, certain organisational processes, such as the new employee induction program, unconditionally rely on the educational Knowledge. Moreover, organisations undertaking KM initiatives are sometimes called “learning organisations” which implies the educational link (Elenurm, T., 2004; Gottschalk, P., 2005; Turban, E., Aronson, J.E., 2000; Waltz, E., 2003). Even though the common layout provides for the lower blocks to feed the upper ones, the opposite can be also true in some cases, e.g., when the organisational Knowledge enriches and cements work processes and practices of the educational institutions, thus affecting the educational Knowledge.

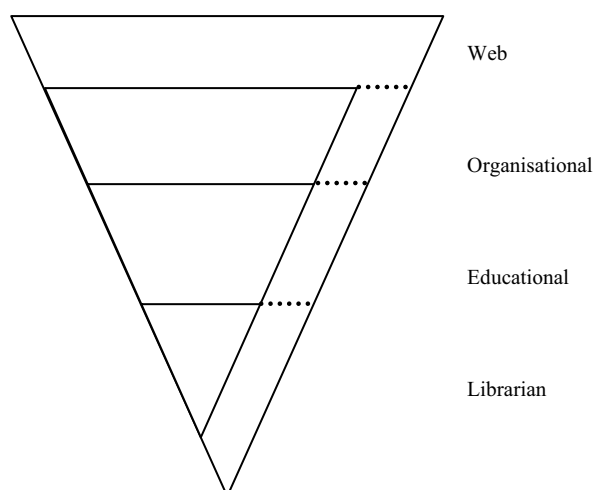


Figure 2.1 Knowledge forms pyramid

More recently, another form of Knowledge, Web Knowledge, appeared to emerge. It may look like a new distinct layer of the Knowledge forms pyramid or as a projection of the pyramid onto another dimension. While it is true that the Web Knowledge does combine the three other forms and, therefore, can be naturally stacked on top of them, it is also possible to see how it can extend all of them individually which implies sideways extensions.

By analogy with the traditional Knowledge forms, the Web form can also be seen as a Knowledge source as many Knowledge entities may well exist on the Web before being converted into a more conventional form. Moreover, perhaps a bit surprisingly, it can also be seen as a Knowledge destination. A further inspection, however, seems to support this statement as every traditional Knowledge form tend to have a Web version with online libraries, online educational programmes and Web-based organisational processes being the prime examples (Sridharan, B., Tretiakov, A., Kinshuk, 2004; Rao, M., 2004).

What makes the Web Knowledge even more complicated is the fact that the border between the tacit and explicit components of Knowledge is rather blurred. Indeed, the Web, as part of the Internet, facilitates a whole set of new communication activities which can start as tacit but end up as explicit and vice versa (Nonaka, I., Toyama R., Konno, N., 2000; Turban, E., Aronson, J.E., 2000). Defining the difference between the tacit and explicit Knowledge is also difficult because, technically, all the information that is digitised can be considered explicit so everything that enters the

Web immediately becomes explicit (Gupta, J., Sharma, S., 2004; Huang, H., Liaw, S., 2001; Rao, M., 2004). Not everything that enters the Web stays there, however, and this is exactly what will distinguish between tacit and explicit components of the Web Knowledge -- their life expectancy (volatility or persistence). Tacit Knowledge is volatile and its lifespan is close to instant while explicit Knowledge is persistent and expected to stay digitally available for a reasonably long time. Instant messaging (IM) or Voice over Internet Protocol (VoIP) are good candidates to represent the tacit component on the Internet but they are not Web technologies as they belong to the previous layers of the Internet functional pyramid (Figure 1.1). Both IM and VoIP by default simply transmit information without preserving it anywhere, therefore, they can communicate tacit ideas without externalising them (Plant, R., 2004). Even though they have no direct Web counterparts, there are still suitable vehicles for tacit Knowledge on the Web. For example, wiki or forum software normally allows editing and removal of any information which effectively means that the lifespan of that information can be close to instant and, therefore, that information can help conveying tacit Knowledge (Dobson, T., Willinsky, J., 2007; Kille, A., 2006; Watson, K., 2007). It has to be agreed, however, that Communication Environment and, sometimes, even Data Environment (Figure 1.1) provide some Knowledge features that are missing from Information Environment (Gupta, J., Sharma, S., 2004). These features, e.g., instant messaging, VoIP communication, sound and video streaming, are also easily available through the Web interface but, technically, they do not belong to the World Wide Web architecture (Dotsika, F., Patrick, K., 2006; Eklundh, K.S., et al., 2001; Stenmark, D., 2003; Turban, E., Aronson, J.E., 2000). Another view on the tacitness could be related to the human element and actionability, or Web activities which facilitate Knowledge processes (Eklundh, K.S., et al., 2002).

Locating the Knowledge characteristics (Table 2.1) is becoming easier with every next level up the Knowledge forms pyramid. Since the librarian Knowledge is on the bottom level, its Knowledge characteristics are quite rudimentary with the human element and the tacit component being completely missing. The Knowledge pyramid (Data, Information, Knowledge) can be found in libraries, sometimes even in one source. An author's point of view can be treated as either Information or Knowledge so it is present in almost any book. Some authors can also introduce additional facts to support their statements or ideas and these facts are naturally translating into the Data

concept. Of course, to see the big picture (the whole pyramid) it is often required to cover several sources on the same subject. But since the libraries always contain only explicit Knowledge, actionability and dynamism that are dependent on the human element and the tacit component, are largely absent (Kille, A., 2006). Sometimes, dynamism in the librarian Knowledge can be found by comparing several sources on the same topic but it may still have a considerable latency. Also, any Knowledge, including the explicit librarian Knowledge can result in actionability but for explicit Knowledge there is always an extra step of absorption or internalisation required before it becomes fully actionable. The human element is obviously present at both the starting point (when the library resource is compiled for externalisation) and the receiving end (when the resource is consumed for internalisation) but not in the librarian environment.

On the following level up the hierarchy is the educational Knowledge which can be seen as the first full-featured Knowledge. There is a whole lot of Data, Information and Knowledge present in any educational process with Data and Information normally coming from the learning material and Knowledge coming either from the learning material or from the teaching staff (Chang, Chi-Cheng, 2003; Gupta, J., Sharma, S., 2004; Turban, E., Aronson, J.E., 2000). The staff are the human element and so are responsible for actionability and tacitness of the educational Knowledge (Huang, H., Liaw, S., 2001). The explicit component can combine both the librarian Knowledge and custom solutions for externalising Knowledge (Gupta, J., Sharma, S., 2004). The mechanisms for supporting dynamism can depend on both tacit and explicit resources but apparently this characteristic is integral and paramount due to the fact that the education is very sensitive about keeping Knowledge up-to-date (Eklundh, K.S., et al., 2001; Gupta, J., Sharma, S., 2004).

The organisational Knowledge is very similar to the previous level in terms of its comprehensiveness of the Knowledge characteristics. Even though the inclusion of the previous two forms, i.e., librarian and educational is not mandatory, many organisations do opt to have them either individually or both. Regardless if an organisation has them or not, it still possesses all the required Knowledge characteristics. Most organisations collect Data either about themselves or about their business area (Gupta, J., Sharma, S., 2004). Those rare exceptions that do not do it,

get such or similar Data from third parties so, ultimately, all organisations have Data (Lee, M., et al., 2006). There is just one step from Data to Information and it is in processing and structuring it according to some rules and it is clear that all organisations have to make this step as they need rather Information than just Data in their work (Turban, E., Aronson, J.E., 2000). Once that Information becomes consumed by the organisation's employees, it can attain all the attributes of Knowledge and so the entire Knowledge pyramid is there (Evans, Z., 2003; Gottschalk, P., 2005; Fahey, L., et al., 2001; Gupta, J., Sharma, S., 2004; Turban, E., Aronson, J.E., 2000). Unless the organisation is only a few people strong, its employees most likely will need to externalise their tacit Knowledge for various reasons and purposes and so here come both tacit and explicit components (Gottschalk, P., 2005). Both actionability and dynamism are naturally present as based on their Knowledge the employees do their jobs and they adjust as their business area changes (Elenurm, T., 2004; Khe Foon Hew, Hara, N., 2006; Turban, E., Aronson, J.E., 2000).

The main target of this work is on the Web Knowledge, however, and it certainly does include all the Knowledge characteristics too. Simply because the Web Knowledge in many cases is just another view on some other, more traditional Knowledge form. The online libraries can be seen as representing the Web view of the librarian Knowledge with all of its Knowledge characteristics (Drexler, E.K., 1995). Interestingly, one of the first theoretical prototypes of the Web -- "memex" -- was based on the library and books example (Allen, C., 2004; Berners-Lee, T., 1996; Eklundh, K.S., et al., 2001; Figallo, C., Rhine, N., 2002). The main problem with the Web Knowledge is in singling out the tacitness (and its determinant, the human element) but the librarian Knowledge does not possess it by definition so its Web view is matching the original quite closely (Kille, A., 2006). With regard to the tacitness, as previously mentioned, on the Web it can be found by examining the lifespan of the transmitted information. If Information is persistent enough, it can result in explicit Knowledge while the volatile Information can be expressing tacit Knowledge. Certain Web activities can manifest the tacitness too, but, still, as shown before, more naturally it exists on the previous two levels of the Internet functional pyramid (Figure 1.1). Also, Data and Information Environments of that pyramid typically serve Data and Information levels of the Knowledge pyramid (Figure 1.2) quite well so the entire Knowledge pyramid is there on the Web.



Since one of the main goals of computerisation was to reduce the involvement of the human in certain areas, the human element by default is not required for the faultless work of most computer systems. Therefore, the Web, which is a subsystem of the Internet -- apparently the biggest computer system in the world, does not expressly need the human element for its proper functioning (Berners-Lee, T., 1996). It can have and it does normally have some degree of the human participation but the Web will not suffer technically if all people suddenly go offline because the human presence is optional and irregular (Stenmark, D., 2003). What this implies is that the role of the human element on the Web, in general, and in the Web Knowledge, in particular, is very different to the traditional, offline representations. While for the librarian Knowledge the human element is not important because this Knowledge operates on the explicit level only, both the educational and organisational Knowledge ultimately depend on it. This explains why putting online the librarian Knowledge is much easier than the other two forms which both require properly addressing the specifics of the human element to be really adequate. In the real world, for most Knowledge activities on the educational and organisational level, the human must be present and compliant which is hard to guarantee on the Web due to the mentioned reasons. So only when the human comes online, the Web becomes a truly interactive Knowledge environment and its Knowledge resources become actionable (Eklundh, K.S., et al., 2001; Huang, H., Liaw, S., 2001). All the other time the Web Knowledge is dormant but it may well retain dynamism as, thanks to its computerised structure, it can update itself autonomously as its underlying content changes (Bergeron, B., 2003; Dotsika, F., Patrick, K., 2006). For example, the module material in the educational institutions or the corporate policies in the organisations may be automatically re-published on the Web whenever they are modified in the internal systems (Turban, E., Aronson, J.E., 2000). When the human is online, the Web Knowledge is implicitly dynamic because both content producers and content consumers in their majority are usually interested in the most up-to-date content (De Judicibus, D., 2008; Plant, R., 2004). It is worth noting, however, that in addition to being a positive medium for immediate access to the current versions, the Web is also a very favourable environment for keeping and providing a historical record on almost any perceivable subject and, therefore, it can be considered the largest library in the world (Dobson, T., Willinsky, J., 2007; Jana, S., Chatterjee, S., 2004).

Even though the Web version of the educational Knowledge can not completely substitute the traditional educational Knowledge, it can and it should complement it (Alexander, B., 2006; Chiles, A., 2008). With electronic Information growing much faster than any other form of it, it is often becoming the only source of specialised Knowledge and ignoring it would mean leaving that Knowledge aside (Alexander, B., 2006). Of course, the role of the human element, which is crucial for the educational Knowledge, is changing as this Knowledge goes on the Web and fully digitising it is indeed impossible, but with proper preparation and adjustments the Web does appear to be a very comprehensive and efficient educational environment (Alexander, B., 2006; Chang, Chi-Cheng, 2003; Gupta, J., Sharma, S., 2004; Turban, E., Aronson, J.E., 2000). Employing both the Web means and other Internet technologies, the educators and the educatees can easily communicate and conduct different tasks online regardless of the time, location and subject (Eklundh, K.S., et al., 2002; Huang, H., Liaw, S., 2001; Turban, E., Aronson, J.E., 2000; Waltz, E., 2003). That is the manifestation of the tacit component whereas the explicit Knowledge resides in the abundance of electronic resources easily available nowadays (Chiles, A., 2008). The electronic content is generally more dynamic (Gupta, J., Sharma, S., 2004). As more and more traditional modules and programmes get their Web versions, distance learning courses are proliferating and certain courses are even created specifically for the online education, which is now commonly called e-learning, there are no longer questions about the suitability of the Web for the educational purposes and the educational Knowledge (Alexander, B., 2006; Rao, M., 2004; Sridharan, B., Tretiakov, A., Kinshuk, 2004; Turban, E., Aronson, J.E., 2000; Weaver, A.C., 1998).

The organisational Knowledge develops in a similar direction except for the highlighted difference with regard to its limitation for internal use only (Eklundh, K.S., et al., 2001). This implies that instead of the Internet, the organisational Web Knowledge lives largely within the boundaries of the organisational Intranets (Gottschalk, P., 2005; Stenmark, D., 2003; Todd, S., 1999). Despite what the name implies, most of the concepts of the World Wide Web can be applied to and implemented on the intranets too (Herder, P.M., et al., 2003; Turban, E., Aronson, J.E., 2000). Moreover, the organisational Intranets are normally only restricted from the access from the outside with the external communications initiated inside are typically

allowed (Berners-Lee, T., 1996; Plant, R., 2004). This way the internal Knowledge can grow but at the same time it remains a protected asset -- it can access and leverage the external resources but it cannot be accessed and leveraged by the outside world (Figallo, C., Rhine, N., 2002). Except for this difference in scoping and targeting, the organisational Web Knowledge shares a lot of similarities with its librarian and educational forms. It can have considerable repositories of the externalised librarian Knowledge with the traditional librarian resources complemented with relevant organisational documentation on existing policies, processes, values and objectives that are digitised and put on the Web (Gottschalk, P., 2005; Rao, M., 2004). It can also have online programmes and processes for promoting and delivering the educational Knowledge as well as its specific organisational Knowledge (Gupta, J., Sharma, S., 2004; Khe Foon Hew, Hara, N., 2006; Turban, E., Aronson, J.E., 2000). Even though the organisational Knowledge is an important asset and closely guarded within the organisational boundaries, in certain cases it is allowed to be exposed either on the Web or in some other public environment, e.g., for customer support or marketing activities (Gupta, J., Sharma, S., 2004; Rao, M., 2004; Turban, E., Aronson, J.E., 2000). This exposure is usually elaborate and moderate but it is still one of those rare situations where the organisational Knowledge is deliberately communicated outside the organisation and the Web provides one of the easiest and most efficient ways of doing it (Karayanni, D., Baltas, G., 2003). In brief, the reason why the Web is becoming the dominant Knowledge medium for the organisations is that most of them have significant amount of their documentation and processes computerised and the most popular and functional approach to design and integrate various computer programs is with the Web interface (Berners-Lee, T., 1996; Gupta, J., Sharma, S., 2004). It just happens so that this interface also possesses the Knowledge characteristics but the original reason of its selection was most likely more prosaic and was in trying to cover all legacy systems under one umbrella (Rao, M., 2004; Stenmark, D., 2003). But now the organisations realise that the Web provides a framework for not only cementing the legacy resources and facilitating the procedural activities but also for stimulating and incorporating Knowledge work (Figallo, C., Rhine, N., 2002; Gaines B., Shaw, M., 1997; Gottschalk, P., 2005; Hameri, A.-P., Puitinen, R., 2003; Stenmark, D., 2003; Tiwana, A., 1999; Turban, E., Aronson, J.E., 2000).

In addition to being a reflection of the other forms of Knowledge, the Web also has its own, specific Knowledge with no traditional equivalent (Alexander, B., 2006; De Judicibus, D., 2008). There are many situations when Knowledge originates on the Web and while the generic Knowledge can often be converted into another Knowledge form, some specific Knowledge may well remain purely Web-based forever (Elenurm, T., 2004). Social software like blogs, forums or wikis can be named as the main Knowledge generating mechanisms on the Web (Alexander, B., 2006; Allen, C., 2004; Boyd, D., 2007; Dobson, T., Willinsky, J., 2007; Dotsika, F., Patrick, K., 2006; Kille, A., 2006). They exist only on the Web and, therefore, it is valid to say that Knowledge generated with their use is the Web Knowledge. Other major indigenous sources of the Web Knowledge are users' comments, experts' reviews and search facilities. Some news also are published online before being aired on the TV or sent to press (Dobson, T., Willinsky, J., 2007; Karayanni, D., Baltas, G., 2003; Weaver, A.C., 1998). Many references and manuals either begin their life on the Web or spend it there altogether. Since these and some other Knowledge producing mechanisms are unique to the World Wide Web, their product, i.e., Knowledge is also distinctly unique because at some stage the only place it exists in is the Web (Dotsika, F., Patrick, K., 2006). This Web Knowledge can both rely upon and feed into other Knowledge forms and it can grow on the independent sites as well as on the sites located in organisations, educational institutions and even libraries. It can really emerge anywhere on the Web, the only prerequisite being, as with other Knowledge forms, in the human element (De Judicibus, D., 2008). But after all, Knowledge is a human-based and human-centric concept that does not exist beyond the human consciousness (Gottschalk, P., 2005; Hey, J., 2004; Rao, M., 2004).

Therefore, the Web Knowledge appears to be quite separate from the other forms and at the moment it does look as the top level of the Knowledge forms pyramid (Figure 2.2) because it can combine and enrich the lower forms and can also extend them individually. It is worth noting here that “source”, “environment” or some other meaningful equivalent could also be used to describe these four Knowledge levels but the term “form” was chosen because it was most succinct, generic and universal at the same time. Such a Knowledge form can also correspond to a shared context or ba (Nonaka, I., Toyama R., Konno, N., 2000). Characterising the four examined

Knowledge forms in one word would probably result in: *idle* (librarian), *abstract* (educational), *practical* (organisational) and *virtual* (Web).

## **2.2 Knowledge on the Web**

### *2.2.1 Yesterday*

The World Wide Web was developed by Tim Berners-Lee at CERN (Conseil Européen pour la Recherche Nucléaire -- European Organization for Nuclear Research) in Switzerland in late eighties-early nineties and officially presented to the world on August 6, 1991 (Berners-Lee, T., 1996; Todd, S., 1999; Weaver, A.C., 1998). The original intention was quite simple -- to share information in heterogeneous environments but the result had much more far-reaching consequences with the last decade being dominated by hoards of Web-related, Web-based and Web-enabled breakthroughs and buzzwords. Still, most of them rely on the same simple and effective means of access to the shared information resources which were the driving factors behind Berners-Lee's invention almost 17 years ago (De Judicibus, D., 2008). Interestingly, the Web invention can be seen related to the educational Knowledge as what people at CERN really wanted to do was to share research, and, thus, educational information, between fellow colleagues (Weaver, A.C., 1998).

Similar ideas were in existence long before that time, however. If Tim Berners-Lee is the father of the WWW, then it is fair to call Vannevar Bush its grandfather because it is him who is credited with contemplating the Web idea first (Berners-Lee, T., 1996; Eklundh, K.S., et al., 2001; Figallo, C., Rhine, N., 2002). The concept he contrived in 1945 was "memex" and it was encompassing both the PC and Web functionality. "Memex" was largely based on a books example so it can be seen as operating on the librarian Knowledge (Allen, C., 2004). Bush described "memex" using notions which can translate into today's hypertext and hyperlinks and it was stimulated by the need to address the fast growing stores of information. The terms themselves were forged by Ted Nelson in 1965 while he was trying to materialise Bush's concepts in a somewhat crude project Xanadu (Berners-Lee, T., 1996; Dobson, T., Willinsky, J., 2007; Gupta, J., Sharma, S., 2004). The first successful implementation of hypertext, however, was

oNLine System (NLS), completed in 1968 by another Bush's follower, Doug Englebart, when he was working for Advanced Research Projects Agency (ARPA). The previous year Englebart also invented the computer mouse and the following one took part in implementing ARPANET that was the prototype of today's Internet (Allen, C., 2004; Todd, S., 1999). Naturally, the main purpose of ARPANET was also to facilitate resource sharing (Boyd, D., 2007; Dobson, T., Willinsky, J., 2007; Figallo, C., Rhine, N., 2002; Weaver, A.C., 1998). One of the projects run on ARPANET was Electronic Information Exchange System (EIES) that pioneered many of the Bulletin Board System (BBS) concepts (Allen, C., 2004). The BBS was the precursor to the whole set of social software that is so popular now and still remains one of the main Knowledge-generating mechanisms in form of today's discussion boards or forums (Figallo, C., Rhine, N., 2002). EIES influenced a considerable number of new technology and terminology offsprings with the one of particular interest being the term "groupware" which was coined in 1978 to describe "intentional group processes plus software to support them" (Allen, C., 2004). The first significant products to adopt it were Lotus Notes and Microsoft Exchange but today almost any software that supports multiple users can be legitimately called groupware so this term has slowly lost its meaning and a new phrase, "social software" has started to come into vogue (Allen, C., 2004; Boyd, D., 2007; Figallo, C., Rhine, N., 2002).

Even though all the mentioned technologies and reflections are clearly Knowledge-related, the Web arguably attained the most Knowledge momentum with the advent of social software that belongs to so-called Web 2.0 movement, or the next generation Web (Alexander, B., 2006; Dotsika, F., Patrick, K., 2006; Patrick, K., Dotsika, F., 2007). The term itself was most likely invented by Eric Drexler in 1987 but did not take off until 2002 when it started to gain popularity (Allen, C., 2004; Drexler, E.K., 1995). Still, despite its overwhelming popularity it does not seem to have a universally agreed definition or classification. In fact, social software not always functions in the Information Environment of the Internet functional pyramid but rather on Data or Communication levels (Figure 1A). For example, Instant Messaging or podcasting are not Web technologies. From the Knowledge point, the most interesting Web-based members of social software are blogs, discussion boards/forums and wikis (Chang, Chi-Cheng, 2003; Dobson, T., Willinsky, J., 2007; Gottschalk, P., 2005; Erickson, T., Kellogg, W.A., 2001; Kille, A., 2006; Lu, H., Hsiao, K., 2007; Rao, M., 2004; Watson,

K., 2007). These technologies can also be used in some formal boundaries but their true potential is demonstrated in the informal, open Web environment with only a reasonable amount of moderation. It should also be noted that, as the name suggests, social software is first of all designed for casual socialisation which does not necessarily imply much Knowledge value per se. But since socialisation is effectively a part of the Knowledge creation process, it can indeed be seen as a Knowledge-generating activity (Nonaka, I., Toyama R., Konno, N., 2000; Rao, M., 2004; Tiwana, A., 1999). In fact, this is perhaps the best proof of the potential Knowledge value of social software because any socialisation can result in new Knowledge.

So, exactly as predicted by its creators, the World Wide Web has become a social phenomenon (Berners-Lee, T., 1996; Plant, R., 2004). And this is, perhaps, what made it so suitable for KM that is rooted deeply in the social context (Erickson, T., Kellogg, W.A., 2001; Gaines B., Shaw, M., 1997). The Web attracted people and those people synthesised Knowledge and ignited KM processes.

### 2.2.2 Today

From its very inception, the Web was meant to be a multi-functional and multi-purpose environment with the main forms of its usage being: a) Travel and Leisure; b) Investment and Finance; c) Shopping; d) Real Estate; e) Medicine; f) Education; g) Science and Engineering; h) Libraries and Research; i) Computers; j) Weather; k) News and Current Events; l) Museums; m) Finding People; n) Keeping Yourself Informed (Stenmark, D., 2003; Weaver, A.C., 1998).

That rather long description can be condensed into three big categories:

- *Knowledge activities* (Education; Science and Engineering; Libraries and Research; News and Current Events; Museums; Keeping Yourself Informed);
- *Procedural activities* (Travel and Leisure; Investment and Finance; Shopping; Real Estate; Medicine; Science and Engineering; Computers; Weather; News and Current Events; Museums; Finding People; Keeping Yourself Informed);
- *Leisure activities* (Travel and Leisure; Libraries and Research; Computers; News and Current Events; Museums; Finding People;).

It is evident that these categories are not mutually exclusive and quite often a Web site can belong to several or even all of them. For example, Travel and Leisure can be fairly classified as both Procedural and Leisure activities because they may involve a considerable bit of robotic processing in addition to an evident Leisure ingredient. Blogging or booking holidays online can illustrate this example.

Knowledge activities are in using the Web either as a Knowledge resource or as a medium to do Knowledge-intensive tasks (Eklundh, K.S., et al., 2001). When used as a resource, the Web can be seen as a form of the librarian Knowledge as it is completely explicit and does not have the human element on the producer end. In other words, the content producers and content consumers are not required to operate in a synchronous manner so, technically, the consumption may be a continuous process while the production may happen quite irregularly. When the World Wide Web is used as a Knowledge medium, however, it does imply that both the producers and consumers stay online simultaneously (Figallo, C., Rhine, N., 2002). This connotes the interactivity and, thus, tacitness. Apparently, the most practical approach is to use the Web as both the Knowledge resource and Knowledge medium leveraging its vast explicit Knowledge repositories as well as its peerless tacit communication means. It is also suggested that two of the main job-related activities conducted on the Web are problem solving and Information gathering which are both clearly Knowledge-related (Hiner, J., 2008). In one word, Knowledge activities can be described as *answers*. Answers can be difficult to get, indefinitely extended, incomplete and intertwined (Gottschalk, P., 2005; Rao, M., 2004).

Procedural activities are in routine tasks that do not pose big mental challenges or do not require big mental efforts. Normally, they are repeated on a regular basis but can also be one-off endeavours of a simplistic or intuitive nature (Rao, M., 2004). *Transactions* would be the word to characterise them because such activities are mostly time-limited, discrete, autonomous and unambiguous (Gottschalk, P., 2005).

What does not fall in either of the mentioned categories effectively belongs to Leisure activities and can be summed up with the word *fun*. It can be purposeless browsing,



game playing, communicating with close people or strangers, reading or writing some incoherent material or anything at all lacking in meaning, objective or effort.

Getting answers might or might not be the most dominant use of the Web at the moment but it is arguably the primary driving force in attracting new users to the Web. As with most other areas, before doing anything meaningful in the Web, the Web must be first explored and learned. This naturally translates into getting answers which, in turn, points to the Knowledge side of it. So even if the foremost intention of the newcomer is to do transactions (Procedural activities) or have fun (Leisure activities), the Knowledge activities would have to be invoked first. After the initial learning curve of the World Wide Web gets exhausted, Knowledge activities might be put on the shelf either for good or until the next learning curve starts in some other area. This Knowledge side of the Web is indeed inevitable but because it is invoked unintentionally and unconsciously, it is rather a side effect than a principle. The principle examined here posits that the Web is a Knowledge environment and since Knowledge is a product of the human consciousness, it implies conscious applications. Unconscious or unintentional applications are not automatically discarded, they are just considered complementary to the main proposition.

Apparently, Leisure activities are an undisputed leader among the three because the virtual space increasingly becoming the number one place to disconnect, relax or just do something for fun (Figallo, C., Rhine, N., 2002). Knowledge activities are already outweighing Procedural activities and the gap is likely to widen (Gottschalk, P., 2005; Rao, M., 2004). When more and more businesses go online, however, a couple of scenarios are possible. If people spend more time online (either for Knowledge or Procedural activities), they may not want to stay there for Leisure activities also and go for an offline rest instead. This way, in a fully automated world, Leisure activities may drop to the end of the list as people will prefer to have at least some time offline in their entirely online lives. On the other hand, there is no guarantee that Knowledge activities will not succumb to Procedural activities in such a robotic environment. For now, however, Procedural activities are in the tail while Leisure activities are the frontrunners.

As stated previously, a good proof of the Web suitability for various Knowledge activities and, thus, Knowledge Management as such can be in demonstrating the existence of Knowledge and its three generic processes: Knowledge creation, Knowledge sharing and Knowledge usage (Table 2B). The existence of Knowledge itself was shown by conceptualising the Web Knowledge form that possesses all the necessary characteristics of Knowledge (Table 2A). Locating the core Knowledge processes requires a deeper examination of the spectrum of Knowledge activities conducted on the Web.

Knowledge creation is effectively either a full SECI (socialisation, externalisation, combination, internalisation) cycle or a subset of SECI processes (Nonaka, I., Toyama R., Konno, N., 2000). Socialisation is an exchange of tacit Knowledge and it is quite easy to find it on the Web, especially in the ecosystem of social software where Instant Messaging (IM) and chat applications provide great means for real-time communications (Dotsika, F., Patrick, K., 2006). As pointed previously, due to its volatile nature, pure tacitness is actually difficult to achieve in the pure Web environment but tools like wikis, forums and blogs come very close to expressing it properly (Kille, A., 2006). Social software, by its own definition, is all about socialisation but it can also take part in the other three subprocesses. It is important to note, however, that while socialisation insists on both producers and consumers to be present online simultaneously, even if they occasionally swap roles, externalisation, combination and internalisation normally only require either producers or consumers at any one point in time and, therefore, are much easier to implement with more traditional Web technologies. Externalisation is essentially about creating from tacit Knowledge some content, be it via publishing a static Web page or writing on a blog. Externalisation can be seen as done by Knowledge producers who extract and crystallise their Knowledge outside. Combination means conversion from one format of explicit Knowledge into another and it is even easier than externalisation because there may be no need to create anything in the first instance. Simply putting an internal document or a report from a database or expert system on the Web is doing just that. Combination can involve a reasonably sophisticated conversion or even one or two interim SECI subprocesses, e.g., internalisation from the old format before externalising into a new one, but in many situations it can be the easiest step indeed. Just mentioned internalisation implies absorption of explicit Knowledge by the human

resulting in the human having tacit Knowledge. It is normally done by Knowledge consumers by reading or just simply watching the Web content. Apparently, both social software and other Web technologies can help with externalisation, combination and internalisation processes but for socialisation social software currently appears to be its most prominent enabler. Therefore, Knowledge creation is intrinsically present on the Web (Dobson, T., Willinsky, J., 2007).

Knowledge sharing can also be easily done on the Web following principles close to SECI processes. Except for internalisation that is mainly about the consumption, all the other SECI components imply sharing of either tacit or explicit Knowledge. Socialisation inherently means Knowledge sharing between the producers and consumers while both externalisation and combination processes can result in sharing of explicit Knowledge by the same means as above. An important point to note is that Knowledge sharing in informal communities is largely driven by motivations (Lee, M., et al., 2006). Still, the Web is arguably the best platform for Knowledge sharing, especially across geographical boundaries (Eklundh, K.S., et al., 2001).

Knowledge usage is both the simplest and the hardest step to describe. It is simple because all people coming after Knowledge are intending to actually use it. Knowledge can indeed be collected and stored without putting it to immediate use but ultimately Knowledge is an expendable rather than collectible commodity so its main purpose is to be used. How it is going to be used is the difficult part, however. In the organisational context Knowledge usage can be aligned with organisational objectives but on the Web most of the time it is totally individual. Similarly to Knowledge creation, Knowledge usage relies on the complete SECI cycle as both tacit and explicit Knowledge may be needed and used. The mechanisms to extract the Web Knowledge for usage can be identical to described before. A very powerful and unique to the Web mechanism for Knowledge discovery that is indispensable for the successful Knowledge usage is a Web search (Herder, P.M., et al., 2003; Hiner, J., 2008; Rao, M., 2004; Turban, E., Aronson, J.E., 2000).

Thus, the whole set of core Knowledge processes appears to naturally exist on the Web supporting the hypothesis of feasibility of Knowledge and Knowledge Management activities online. Interestingly, Nonaka's SECI cycle can also feed Knowledge sharing

and usage processes in addition to the creation one which it was specifically devised for.

One reason the Web is so suitable for Knowledge activities is because it is designed to handle unstructured data in different formats well (Rao, M., 2004). Knowledge is a blend of intertwined concepts and its environment must provide necessary mechanisms to support such ethereal notions which the WWW naturally does. This, together with its hyperlinked, networked, and flexible organisation, makes the Web a perfect ecosystem for Knowledge and Knowledge-related activities (Stenmark, D., 2003). People engaged in such activities form Knowledge communities that are largely based on trust and motivation (Eklundh, K.S., et al., 2001; Erickson, T., Kellogg, W.A., 2001; Figallo, C., Rhine, N., 2002). Since there is no strict hierarchy and control on the Web, people must be motivated to contribute and they must also trust what they receive. This also raises an important question of quality which is difficult to expect in such conditions. The main solutions to this problem are either getting the information from formal sources with more stringent obligations with regard to quality or locating multiple proofs to the same statement in different informal sources. Even if the quality of the information retrieved from the Web may not be highest, the overall value is most likely going to be the best if the cost, convenience and speed variables are taken into account.

In contrast to formal environments where duties may be explicitly assigned, on the Web people routinely swap the roles of consumers and producers depending on the situation and motivation (Stenmark, D., 2003). Users themselves are interested in engaging socially with one another, and, in the process, creating, sharing and using Knowledge relevant to their common goals (Eklundh, K.S., et al., 2001; Erickson, T., Kellogg, W.A., 2001). Diversity and ad hoc behaviour are the norm for Knowledge activities on the Web (Gottschalk, P., 2005). But its open and liberal character does prove to be a more and more persistent challenger to the traditional hierarchical and controlled organisational environments with regard to Knowledge and Knowledge Management capabilities.

### *2.2.3 Tomorrow*

It is difficult to foresee how will the current Web look tomorrow but the consensus is that two of the most influential factors in its development will most likely be Web 2.0 and Semantic Web. Since both are inherently Knowledge-related, the Knowledge value of the Web should only increase (Dotsika, F., Patrick, K., 2006).

The Web 2.0 trend that encompasses an array of interactive applications of the Web can be seen as a natural enhancement over the current version but many experts argue that it is rather another buzzword denoting many existing technologies and concepts (Alexander, B., 2006; Dotsika, F., Patrick, K., 2006; Lu, H., Hsiao, K., 2007; Patrick, K., Dotsika, F., 2007). Web 2.0 appears to be more of an attitude than a technology because it promotes the online collaboration principles from the user's point of view rather than the technological standpoint (Watson, K., 2007). Its philosophy emphasises that anyone coming on the Web is encouraged not only to consume its resources but also to contribute to them effectively turning consumers into producers, or prosumers (Stenmark, D., 2003). Further ambiguity to the term Web 2.0 adds the fact that it is often used interchangeably with the term "social software" introduced above. The difference is probably that Web 2.0 denotes an idea while social software describes the set of technologies expressing this idea. In contrast, the commonly known World Wide Web, or Web 1.0, represents both the idea and the implementation.

In addition to previously mentioned forums, blogs and wikis, many other technologies, concepts and just popular online resources fall under the Web 2.0 realm. Social bookmarking, Really Simple Syndication (RSS), folksonomy, microcontent, del.icio.us, Flickr.com, MySpace.com, Amazon.com and Google Maps are all mentioned in the Web 2.0 context (Alexander, B., 2006). Obviously, they all have different Knowledge value but since they are all human-centric entities and operate on the "wisdom of crowds", they do possess some Knowledge (Alexander, B., 2006). Moreover, sometimes Web 2.0 is explicitly called a knowledge-oriented environment because it revolves around the human interactions and Knowledge (De Judicibus, D., 2008).

Still, it is worth remembering that in essence Web 2.0 is already here today and so may not be an important thing tomorrow. It is definitely if not Knowledge-based then, at least, Knowledge-related but whether it will be the main Knowledge technology of tomorrow remains to be seen. The same uncertain is the future of another promising buzzword with high Knowledge content -- Semantic Web.

Whereas Web 2.0 deals mainly with the tacit Knowledge, Semantic Web is more about the explicit representation. The cornerstone of any existing versions of the Web, be it 1.0 or 2.0, is in its hypertext fundamentals. The conventional hypertext mark-up provides syntax but lacks semantics, an issue that Semantic Web tries to overcome (Dotsika, F., Patrick, K., 2006). The driving idea behind the Semantic Web paradigm is to automate the usage of Web resources (Berners-Lee, T., 1996; Berners-Lee, T., Hendler, J., Lassila, O., 2001; Shadbolt, N., Hall, W., Berners-Lee, T., 2006). Since the usage will be performed by robots or agents, it is only explicit Knowledge that can be affected because tacitness requires the human element. The current Web was designed for human consumption and this is why it excels at handling unstructured data but Semantic Web aims at structuring it for computer processing (Stumme, G., Hotho, A., Berendt, B., 2006). The representation of formal knowledge structures in semantic networks is common in Knowledge acquisition tools because it is easier to use the Knowledge model when presented in diagrammatic form (Gaines B., Shaw, M., 1997). Semantic Web tries to bring this idea to the Web and add some meaning or context to the otherwise ignorant hypertext. It still relies on old technologies such as HTML and XML but it blends them with new standards such as Resource Description Framework (RDF) and Web Ontology Language (OWL) (Dotsika, F., Patrick, K., 2006). The main principle behind Semantic Web is to try describing all important entities within a domain in a uniformly machine-understandable language so those entities can be easily found and distinguished from any irrelevant ones by automated agents rather than humans. The key concept for this is ontologies but since they require significant standardisation efforts which could violate the original unstructured and decentralised principles of the Web, the future for Semantic Web does not look too good or, at least, too close. Even its creator, the Web's father Tim Berners-Lee, admitted that the simple idea behind it remains largely unrealised (Shadbolt, N., Hall, W., Berners-Lee, T., 2006).

Perhaps realising the diminishing potential of Semantic Web or, maybe due to some other reason, Tim Berners-Lee recently attempted to shift attention to yet another uni-lettered acronym -- GGG or Giant Global Graph (Berners-Lee, T., 2007). In addition to his favourite brainchild, the WWW, he also suggested to apply a similar acronym to the Internet and call it the International Information Infrastructure (III). It does demonstrate a high level of linguistic sophistication but does not really give much support to the GGG claims which appear to be just a different name for Semantic Web. The GGG can also be seen as a blend of Web 2.0 and Semantic Web since much emphasis is put on the social side of the Web usage. The III links computers while the WWW links documents but it is "not the documents, it is the things they are about which are important", noted Berners-Lee. And it is not the social network sites that are interesting, it is the social network itself. He called it the social Graph and indicated that it is a natural evolution of today's Web. It may well be the Web's successor but can also be an insider's manoeuvre to cover up the Semantic Web insolvency. Either way, the GGG idea looks very Knowledge relevant with both tacit and explicit components combined to create a theoretical Knowledge framework perfectly suited for the human needs tomorrow.

Web 2.0 is here and already working on a global scale today while Semantic Web is more on a conceptual level and not guaranteed even tomorrow so they both are not very suitable for a feasible forecast. Web 2.0 is gathering more and more technologies under its name but the term still denotes a philosophical idea rather than a technological mechanism. Obviously, its Knowledge capabilities, especially with regard to the tacit component and human presence are quite powerful but its ambiguous definition, scope and implementation raises more questions than answers and, therefore, cannot be considered a definite Knowledge enabler of tomorrow. The Web 2.0 ideas will most likely be flourishing tomorrow just as they are today but there will hardly be any dramatic Knowledge-related changes. Semantic Web, on the other hand, has a solid scientific background and a clear Knowledge potential but faces implementation difficulties due to the unstructured and spontaneous nature of the current Web. They both seem to be married to provide almost perfect Knowledge environment in the GGG essay but it appears even more remote. On a side note, if Semantic Web is suggested to be a good starting point for the Wisdom Web which is

one level higher than the Knowledge Web, then a perfect Knowledge environment might be closer than we think (Rowley, J., 2006).

### ***2.3 Existing Gaps***

The World Wide Web as a research area is relatively new so its different usage patterns and potential are still largely unexplored, especially with regard to qualitative, longitudinal studies (Eklundh, K.S., et al., 2001). Knowledge itself is an ancient axiom but can be seen a relatively young concept in the KM context. Despite the fact that the World Wide Web and Knowledge appear so intertwined, their symbiosis or, at least, their strong rapport, were rarely highlighted, let alone examined in detail. Moreover, those occasional studies conducted on the subject seem to suggest existence of good prospects of this combination (Bramer, M., 2003; De Judicibus, D., 2008; Eklundh, K.S., et al., 2002; Gaines B., Shaw, M., 1997). The main difficulties with it could be that most researches viewed Knowledge in the KM context which traditionally implied formal boundaries and control mechanisms that are both largely inexistent on the Web. Its informal and spontaneous nature can indeed make the Web imperfect for KM activities but it does not expressly signal the end to any attempts to port KM online. If the existence Knowledge itself on the Web was in focus of some Knowledge practitioners before, the feasibility of KM on the Web was covered rather insufficiently.

The Web Knowledge as a separate entity or Knowledge form was not properly examined either. It is commonly accepted that there is the organisational Knowledge. Less commonly and rather implicitly some concepts of educational and librarian Knowledge are also recognised. But there is nothing to indicate that the Web Knowledge can be considered on the par or even above those traditional Knowledge forms. It appears to be a major deficiency to neglect such a powerful Knowledge form.

So the following gaps appeared as having had inadequate coverage:

- Driving factors for the Web usage;
- The Web as a separate form of Knowledge;



- The Web as a Knowledge environment;
- Knowledge Management feasibility on the Web;
- Knowledge Management feasibility in informal environments.

They all underwent a considerable theoretical and conceptual scrutiny in the previous paragraphs and in the following sections some of them will be subject to practical and technological tests.

Existing timeframes do not allow to make it longitudinal but this study does aim to address both qualitative and empirical aspects of the raised questions.

## ***2.4 Summary***

The Web is growing rapidly with regular new developments in its technicalities as well as its usage forms (Eklundh, K.S., et al., 2001). And Knowledge was inherently present in almost all ideas behind the Web, starting from Vannevar Bush's "memex", dubbed the first modern knowledge network, to the pervasive social software of today and ontological Semantic Web of tomorrow (Berners-Lee, T., 1996; Figallo, C., Rhine, N., 2002; Stenmark, D., 2003). The immense popularity of the World Wide Web is based on the fact that it can facilitate like no other known means or technology two basic human desires to connect to other human beings and to obtain knowledge (Plant, R., 2004).

Assuming Knowledge is a concept defined by its specific characteristics (Table 2A), four Knowledge environments or forms (librarian, educational, organisational and Web) were identified with the Web Knowledge being the most advanced because it can combine them all as well as expand them individually. How the Web Knowledge builds on and, in some sense, supplants the librarian Knowledge can be seen everywhere with digital books and electronic lookups beating the traditional counterparts hands down (Hiner, J., 2008; Weaver, A.C., 1998). It is not that unilateral with the educational and organisational forms where the Web Knowledge normally complements rather than displaces them (Alexander, B., 2006; Chiles, A., 2008; Gottschalk, P., 2005; Hameri, A.-P., Puittinen, R., 2003). Even though the Web, as

most computer systems, was designed to be quite autonomous from human intervention, its full potential, similarly to Knowledge, is demonstrated only in the human context. Also, human presence allows conducting on the Web three main Knowledge processes (create, share and use) thereby showing the feasibility of not only Knowledge concepts but also Knowledge Management ones.

Leisure activities are still dominant on the Web but with more and more businesses going online and more and more tasks getting automated, it is not clear for how long such a distributed will remain in place. Knowledge and even Procedural activities can take the lead in the foreseeable future, especially when such technologies as Semantic Web materialises relatively fast. Overall, Knowledge activities are seen as being a strong driving force of the Web usage today and their position should not suffer much regardless of the scenario the Web develops.

If the Web was originally developed to be a pool of human Knowledge, now it definitely became more of an ocean (Rao, M., 2004; Stenmark, D., 2003). A group has more Knowledge than any one member and with more than a billion of Internet users worldwide, it is easy to see why this ocean can be overwhelming at times and resulting in “Information overload” (Dotsika, F., Patrick, K., 2006; Tiwana, A., 1999; Turban, E., Aronson, J.E., 2000). Obviously, Information is not exactly Knowledge but, as previously stated, their relationship, especially on the Web, is extremely close which points to an obvious difficulty of locating the sought Knowledge in the Web ocean. This is a known challenge and the most common techniques to overcome it are using search engines and participating in the dedicated communities of interest (Eklundh, K.S., et al., 2001). Interestingly, though, in contrast to the notorious “Information overload”, nobody ever complained about “Knowledge overload” (Hey, J., 2004).

The Web, that was started by Tim Berners-Lee as a shared Information space, eventually became a full-featured Knowledge environment or ba (Berners-Lee, T., 1996; Nonaka, I., Toyama R., Konno, N., 2000). Ba is a shared context that can be built intentionally or created spontaneously but it is vital for Knowledge existence and activities. Since the key determinant of ba is interaction, it does appear that the Web is a perfect ba for Knowledge.

The Knowledge potential of the Web was seen for quite a while as there were attempts to port a number of KM application and techniques, such as expert systems, semantic networks, ontologies and repertory grids, to the Web (Gaines B., Shaw, M., 1997). The World Wide Web in its most common, quite static form also provides some Knowledge resources but the true Knowledge potential of the Web was unleashed with the advent of social software technologies that promote social interaction and enable all the necessary means for conveying both tacit and explicit Knowledge as well as conduction all the generic Knowledge processes (Alexander, B., 2006; Dotsika, F., Patrick, K., 2006).

Therefore, the Web, as is, can legitimately be called a Knowledge environment right now (De Judicibus, D., 2008). It does have issues and challenges, e.g., quality control and “Information overload”, but its benefits are definitely outweighing its shortcomings from the Knowledge and indeed Knowledge Management point of view. And in the future, the Web, building on Web 2.0 and Semantic Web and, perhaps, even GGG principles, can enrich not only its own specific Web Knowledge but also traditional librarian, educational and organisational one (Alexander, B., 2006). Eventually, there may even be a shift towards the Wisdom-based, rather than Knowledge-based concepts.

## 3 FRAMEWORK

*“Research is creating new knowledge.”*  
Neil Armstrong

### 3.1 Analysis

The theoretical background of the Knowledge side of the Web was quite comprehensively described in the previous sections. In addition, the Web as a Knowledge environment was found to have a relevant support for both Knowledge resources and Knowledge activities. Here, it is further examined from the practical point of view and the technical means used or possibly used to foster Knowledge resources as well as facilitate Knowledge activities on the Web are perused. There are technology tools that are designed to explicitly support Knowledge Management, so called knowware, but this category is rather limited and specific so in many situations either fully bespoke or heavily customised solutions are required (Gottschalk, P., 2005; Rao, M., 2004; Turban, E., Aronson, J.E., 2000). Both dedicated out-of-the-box products and bespoke tailor-made solutions can be quite expensive so the customisation of the existing software may often be the preferred approach. The customisation can be technical or mental. The technical customisation means some changes in the features and functionality of an existing product to achieve a new goal while the mental customisation implies looking at an application from a different angle to achieve possibly unexpected results without technical modifications. For example, incorporating some interactive or dynamic features to a discussion board usually requires some changes which would result in a technical customisation while encouraging users to shift the emphasis from writing to reading blogs would incur a mental customisation. Normally, some extent of both customisations is mandatory for best results.

A number of specialised implementations of Knowledge systems on the Web demonstrated that both Knowledge processes and repositories can exist there and can be leveraged relatively easy (Eklundh, K.S., et al., 2001; Erickson, T., Kellogg, W.A., 2001). Some of the required features can be found in available off-the shelf applications while others may need in-house customisation or development. Two points are worth noting here: one Knowledge aspect may require several software

applications for its comprehensive implementation but at the same time the same Knowledge aspect can be equally well expressed by different products. For example, for Knowledge usage a search tool alone will never be sufficient as it needs blogs, forums, wikis or any other Knowledge repositories to operate on. On the other hand, blogs and forums can both provide quite adequate means for Knowledge sharing so the choice may be down to individual preferences or specifics (Kille, A., 2006).

Except for the mentioned blogs, forums and wikis that can innately convey Knowledge even if not explicitly designed for it, there are many other tools or even simply features that add value to the Web as a Knowledge environment implicitly. A search facility, for example, is indispensable for Knowledge work on the Web but it is not always explicitly called a Knowledge tool (Hiner, J., 2008; Potosky, D., 2006; Rao, M., 2004). Frequently asked questions (FAQ) and Sitemaps sections are quite common on many sites and they can also be seen relevant in Knowledge context since they serve as a shortcut and, therefore, are often the first place to look at if people want to learn some specific information quickly. Checking the news online is also becoming more and more standard for keeping Knowledge up-to-date. Really simple syndication (RSS) is a technology to allow receiving and reading the updates of some Web content remotely. News tickers are the prime example but RSS can really be used on any Web site with live content including blogs, forums or just frequently updated pages. Users' comments are also a valuable source of hands-on Knowledge. They can be gathered and published with many technologies, from such powerful as the mentioned forums and blogs to basic communication/feedback means and plain hypertext pages. It is important to note here that gathering and publishing users' comments can be separate steps where a user first submits a comment by one means and that that comment can be published by some other means after a possible assessment or correction. Forums and blogs, however, normally publish a comment immediately, preserving a possibility to edit it at a later stage. Another credible origin of insightful Knowledge is in experts' reviews that are somehow similar to users' comments but with a more professional endorsement. They are not as dynamic and random as users' comments and, therefore, are usually hardcoded in plain hypertext pages without any exposure to the outside editing. Electronic books or other reference materials are an obvious Knowledge-related Web entity as they are a Web view of the librarian Knowledge form described previously. With so many parts of daily life getting more and more automated, it is

becoming critical to have a certain level of technical literacy and the Web presents one of the most straightforward ways to it in form of product documentation, user's guides and Knowledge bases widely available and accessible online. Knowledge base is a term that refers to a set of technologies and resources encompassing everything required to get the necessary Information and, thus, Knowledge, on a specific subject. Knowledge bases can include, among others, product documentation, user's manuals, electronic books, references, frequently asked questions, experts' reviews and search facilities.

Consolidating and classifying the above technologies and features can result in the following list:

- *Blogs* (Tacit Knowledge);
- *Communication/feedback means* (Tacit Knowledge);
- *Discussion boards/forums* (Tacit Knowledge);
- *Electronic books/journals/references* (Explicit Knowledge);
- *Experts' reviews* (Explicit Knowledge);
- *FAQ* (Explicit Knowledge);
- *Knowledge Bases* (Explicit Knowledge);
- *News* (Explicit Knowledge);
- *Product documentation/user's manuals* (Explicit Knowledge);
- *RSS* (Explicit Knowledge);
- *Search facilities* (Explicit Knowledge);
- *Sitemaps* (Explicit Knowledge);
- *Users' comments* (Explicit Knowledge);
- *Wikis* (Tacit Knowledge).

Due to the volatile and versatile nature of the Web and its underlying technologies, no comprehensiveness can be claimed here. Instead, an attempt was made to single out only the most common and relevant Web attributes that can positively contribute to Knowledge work online. Each of these characteristics has a different level of contribution that is primarily based on their value and availability but overall they seem to cover a typical Knowledge Web experience quite well. It is practically impossible or rather improbable to see all of them implemented in one place because

some of them overlap and add confusion when combined. On the other hand, there are also some de-facto standards like search facilities or sitemaps that most mainstream sites tend to incorporate regardless of their orientation. It is important to note that all of the specified attributes address at least one of the core Knowledge processes (Table 2B). Also, all of them by default provide explicit Knowledge but some can also convey tacit Knowledge by maximising volatility and minimising persistence of the operational Information.

#	Attribute	References to Research	Example Site
<a href="#">1</a>	Blogs	Alexander, B. (2006); Allen, C. (2004); Boyd, D. (2007); Lee, M., et al. (2006); Lu, H., Hsiao, K. (2007)	<a href="http://www.blogger.com">http://www.blogger.com</a> ; <a href="http://www.livejournal.com">http://www.livejournal.com</a> ; <a href="http://blogs.guardian.co.uk">http://blogs.guardian.co.uk</a>
<a href="#">2</a>	Communication/feedback means	Eklundh, K.S., et al. (2001); Herder, P.M., et al. (2003); Karayanni, D., Baltas, G. (2003)	<a href="http://www.livejournal.com/contact">http://www.livejournal.com/contact</a> ; <a href="https://www.chryslerllc.com/en/contact_us/email">https://www.chryslerllc.com/en/contact_us/email</a> ; <a href="http://www.yahoo.com/r/1p">http://www.yahoo.com/r/1p</a>
<a href="#">3</a>	Discussion boards/forums	Erickson, T., Kellogg, W.A. (2001); Figallo, C., Rhine, N. (2002); Gottschalk, P. (2005); Karayanni, D., Baltas, G. (2003); Lee, M., et al. (2006)	<a href="http://www.dpreview.com/forums">http://www.dpreview.com/forums</a> ; <a href="http://www.adobe.com/support/forums">http://www.adobe.com/support/forums</a> ; <a href="http://pages.ebay.com/community/boards">http://pages.ebay.com/community/boards</a>
<a href="#">4</a>	Electronic books/journals/references	Huang, H., Liaw, S. (2001); Kinga, W.R., Marks P.V.Jr. (2004); Elenurm, T. (2004); Kille, A. (2006); Sridharan, B., Tretiakov, A., Kinshuk (2004)	<a href="http://online.wsj.com/mdc/public/page/marketsdata.html">http://online.wsj.com/mdc/public/page/marketsdata.html</a> ; <a href="http://www.elsevier.com">http://www.elsevier.com</a> ; <a href="http://www.literature.org">http://www.literature.org</a>
<a href="#">5</a>	Experts' reviews	Chang, Chi-Cheng (2003); Eklundh, K.S., et al. (2001); Figallo, C., Rhine, N. (2002)	<a href="http://www.consumersearch.com">http://www.consumersearch.com</a> ; <a href="http://reviews.cnet.com">http://reviews.cnet.com</a> ; <a href="http://www.dpreview.com/reviews">http://www.dpreview.com/reviews</a>
<a href="#">6</a>	FAQ	Bergeron, B. (2003); Bramer, M. (2003); Fahey, L., et al. (2001); Karayanni, D., Baltas, G. (2003)	<a href="http://apache.org/foundation/faq.html">http://apache.org/foundation/faq.html</a> ; <a href="http://www.irs.gov/faqs">http://www.irs.gov/faqs</a> ; <a href="http://www.epinions.com/help/faq">http://www.epinions.com/help/faq</a>
<a href="#">7</a>	Knowledge Bases	Bergeron, B. (2003); Figallo, C., Rhine, N. (2002); Gottschalk, P. (2005); Rao, M. (2004); Waltz, E. (2003)	<a href="http://wiki.forum.nokia.com/index.php/KnowledgeBase">http://wiki.forum.nokia.com/index.php/KnowledgeBase</a> ; <a href="http://kbase.info.apple.com">http://kbase.info.apple.com</a> ; <a href="http://www.adobe.com/support/knowledgebase">http://www.adobe.com/support/knowledgebase</a>
<a href="#">8</a>	News	Chang, Chi-Cheng (2003); Potosky, D. (2006); Rao, M. (2004)	<a href="http://www.guardian.co.uk">http://www.guardian.co.uk</a> ; <a href="http://www.bbc.co.uk">http://www.bbc.co.uk</a> ; <a href="http://www.cnn.com">http://www.cnn.com</a>
<a href="#">9</a>	Product documentation/user's manuals	Elenurm, T. (2004); Herder, P.M., et al. (2003); Potosky, D. (2006)	<a href="http://www.forum.nokia.com/main/resources/documentation">http://www.forum.nokia.com/main/resources/documentation</a> ; <a href="http://docs.sun.com">http://docs.sun.com</a> ; <a href="http://www.apple.com/support/manuals">http://www.apple.com/support/manuals</a>
<a href="#">10</a>	RSS	Alexander, B. (2006); Dotsika, F., Patrick, K. (2006); Kille, A. (2006); Lu, H., Hsiao, K. (2007)	<a href="http://www.guardian.co.uk/rss">http://www.guardian.co.uk/rss</a> ; <a href="http://www.reuters.com/tools/rss">http://www.reuters.com/tools/rss</a> ; <a href="http://www.dpreview.com/feeds">http://www.dpreview.com/feeds</a>

<a href="#">11</a>	Search facilities	Dotsika, F., Patrick, K. (2006); Eklundh, K.S., et al. (2001); Elenurm, T. (2004); Hiner, J. (2008); Rao, M. (2004)	<a href="http://www.google.com">http://www.google.com</a> ; <a href="http://www.yahoo.com">http://www.yahoo.com</a> ; <a href="http://www.msn.com">http://www.msn.com</a>
<a href="#">12</a>	Sitemaps	Karayanni, D., Baltas, G. (2003); Rao, M. (2004); Tiwana, A. (1999)	<a href="http://online.wsj.com/public/page/sitemap.html">http://online.wsj.com/public/page/sitemap.html</a> ; <a href="http://www.adobe.com/sitemap">http://www.adobe.com/sitemap</a> ; <a href="http://pages.ebay.com/sitemap.html">http://pages.ebay.com/sitemap.html</a>
<a href="#">13</a>	Users' comments	Dotsika, F., Patrick, K. (2006); Eklundh, K.S., et al. (2001); Eklundh, K.S., et al. (2002)	<a href="http://online.wsj.com/public/page/letters.html">http://online.wsj.com/public/page/letters.html</a> ; <a href="http://www.epinions.com">http://www.epinions.com</a> ; <a href="http://www.gsmarena.com">http://www.gsmarena.com</a>
<a href="#">14</a>	Wikis	Alexander, B. (2006); Allen, C. (2004); Dobson, T., Willinsky, J. (2007); Kille, A. (2006); Watson, K. (2007)	<a href="http://www.wikipedia.org">http://www.wikipedia.org</a> ; <a href="http://wiki.apache.org">http://wiki.apache.org</a> ; <a href="http://www.ebaywiki.com">http://www.ebaywiki.com</a>

Table 3.1 Knowledge attributes of a Web site

Such characteristics, or Knowledge attributes, can be seen as defining for a sought framework to locate and, possibly, measure the Web Knowledge. Here, this framework is called *Attributive Framework for Assessing Web Knowledge (AFAWK)* because it is effectively defined by the identified Knowledge attributes. Since it is rather subjective, the AFAWK can be also called, perhaps even more appropriately, a rubric.

According to this rubric, *a site is deemed a simple Knowledge node if it possesses at least one of the Knowledge attributes or, in other words, facilitates at least one core Knowledge process while an advanced Knowledge node should allow for all the core Knowledge processes whatever number of attributes it takes. An advanced Knowledge node can also be described as Public Online Knowledge Exchange (POKE) because it is to facilitate unrestricted Knowledge flows between unprivileged members of the public.*

It is imperative that an advanced Knowledge site facilitates Knowledge activities to cover the full cycle of the Knowledge creation, sharing and usage processes but it is not required to itself contain Knowledge resources. This is the fundamental principle of the Web, to hyperlink to a resource rather than contain it, and Knowledge nodes should adhere to it too (Berners-Lee, T., 1996; Figallo, C., Rhine, N., 2002; Stenmark, D., 2003). It is not to say that having Knowledge resources embedded in a site is bad



per se but rather that it does not always add any Knowledge value if those same resources are readily available on the Web. In other words, keeping a possibly outdated Information is definitely worse than a link to an up-to-date version of that Information. It eliminates redundancy as well as maintains dynamism that is an essential characteristic of Knowledge (Table 2A). Having unique resources, however, is obviously positive for any Web site.

While most of the above attributes facilitate only one or two core processes, such powerful Knowledge vehicles as blogs, forums or wikis can exhibit all three alone and, therefore, adding any of them to a site effectively makes it an advanced Knowledge node without any further efforts (Kille, A., 2006). But simply providing technical means for conducting the Knowledge processes on a site or making this site a Knowledge node is worth little without the human participation (Rao, M., 2004). Since any Knowledge process requires the human element, the ultimate criteria for measuring the Web Knowledge revolve around the human involvement. Whereas tracking the human presence online is relatively easy, measuring the level of the human participation is difficult and, generally, unreliable. For example, during an internalisation process people can stay technically idle for quite a long time while being very active intellectually. The number of posts can, to some extent, help gauging the human involvement but overall measuring the Web Knowledge and its value is as difficult as any other Knowledge-related metrics (Eklundh, K.S., et al., 2002).

Certain attributes can habitually use as well as be used for several other Knowledge attributes and it is important to note that it is possible for an attributes to be using as well as being used by the same other attribute, e.g., blogs can provide their own RSS feeds to the interested sites while also using external feeds from the various interesting resources. Therefore, specifying the master-slave dependency unambiguously is not always practical and the attributes potentially used together are considered as peer-to-peer associations.

### **3.2 Metrics**

It is agreed that measuring such thing as Knowledge can not be done by quantitative means only and a good degree of qualitative research is required (Gottschalk, P., 2005; Rao, M., 2004; Stankosky, M., 2005). Whereas measuring Web statistics can normally be done with quantitative metrics, precisely measuring Web usage in the Knowledge context can hardly be done even with the most sophisticated qualitative techniques because of the liberal and spontaneous nature of the Web. In other words, it is relatively easy to measure such things as number of page loads, number of visitors or time spent on the site but it is rather impossible to reliably match these metrics to the purpose of the visit, e.g., if it is for Knowledge or Procedural or Leisure activities. It is primarily because the users can freely come and go anytime they like and their motivations and purposes can routinely change as the users browse the site. For example, a user can visit a friend's blog for fun and then find on the blog some Information relevant to their work and spend some time examining it before logging on to a work server to amend some reports based on the just discovered Information. Such a scenario clearly combines all the three types of activities and it exhibits quite a generic behaviour on the Web. Therefore, it is obvious that simply measuring the usage of any feature on the Web is not the same as measuring its Knowledge value and, moreover, measuring any Web activity scrupulously is impractical. The AFAWK approach suggested here makes use of both quantitative and qualitative metrics and relies on the identified Knowledge attributes to gauge the site's Knowledge value.

Some of the most common quantitative measurements of the site's popularity are the number of visits to the site, their duration and the number of returning visitors (Karayanni, D., Baltas, G., 2003). On the other hand, the qualitative analysis can be conducted on the data related to the visited sections, search terms leading to the site and the geography of the visitors (Jana, S., Chatterjee, S., 2004).

#	Metric	Quantitative / qualitative
1	Page loads	quantitative
2	Visitors	quantitative
3	Returning visitors	quantitative
4	Registered users	quantitative
5	Posts	quantitative
6	Time per visit	quantitative
7	Time between visits	quantitative
8	Site section	qualitative
9	Referrer	qualitative
10	Search engine	qualitative
11	Search term	qualitative
12	Geography	qualitative

Table 3.2 Web metrics

It is important to note that these metrics (Table 3B) help assessing the popularity of the site based on the human participation but do not provide any indication about the site's Knowledge value. To determine its Knowledge value, these metrics must be applied to the previously identified Knowledge attributes that do evince a degree of relationship with Knowledge concepts. All of the metrics imply some form of internal access to the site's server software where they must be implemented and monitored and they are rarely exposed to the external world directly. Also, in order to gather all the relevant Information, certain support from the client's browser is required, e.g., clients must usually allow cookies or some other session tracking mechanism for a proper work of most advanced features on a number of Web resources (Lee, M., et al., 2006; Potosky, D., 2006). The cookies are the main technique for keeping a server session for every unique client. The other two essential characteristics extracted from the client's browser are the IP address and the referrer. The IP address can show the user's origins while the referrer can help unveiling the path that lead the user to the site.

The first metric, page loads, refer to a number of times Web pages are requested from the site. The same page can be counted as many times as it is requested. This is the most fundamental metric and only slightly more coarse than the most granular one – Web hits that reflect requests not only to pages but also all resources referenced by those pages (Jana, S., Chatterjee, S., 2004). Normally, Web hits are too minor a measurement to take into account. Counting page loads does not require the sessions.

Page loads feed directly into the next, perhaps the most important, metric, visits or visitors. A visit starts from the first page load and ends at the last page load for the same user session. Every visit is done by a visitor and, since at any one time one visitor can normally have only one visit to the site, the number of visitors can be seen as equal to the number of visits. Technically, however, if a visitor has multiple connections to the same site from the same browser, it is most of the time counted as one session but if different browsers are used for this, the visitor will have many sessions and, thus, visits. Counting visitors requires the sessions and it is one of the most critical metrics of the site's popularity.

Returning visitors refers to those users that return to the site and it may depend on either the cookies or the IP but not on the sessions directly. This is perhaps the most vital measure of the site's stickiness or magnetism because the value of any resource is best endorsed by those of its customers that used it before and are still motivated to come back again. This is especially true for Knowledge resources that must be cultivated and consulted continuously for best up-to-date and reliable results.

Some of the sites have sections that allow visitors to register for some advanced functionality with blogs, forums and wikis being a good example. Registered users are obviously visitors and most of the time returning visitors too as those who bother registering normally expect to come back for more. Tracking registered users does not directly require any of the mentioned client's features because the user registration is only one of the two metrics (the other is posting) explicitly initiated by the client and explicitly stored on the server. Because it does require some effort on the client's part, this metric is perhaps even more important than returning visitors with regard to magnetism. Registering may appear as the highest form of commitment to an online resource because the user is required to provide certain personal details.

Posting online is another expression of commitment but it may not be as strong as registering because it can be allowed without providing any personal details. Similarly to registering, posting also persists on the server and, therefore, does not depend on any client-side functionality for counting. Posting can be directly present in the following Knowledge attributes: blogs, communication means, discussion boards/forums, users' comments and wikis. Posting may not ask for the user's

personal data but it almost always does require much more effort and so is the best indication of the site's activeness or liveliness status.

Measuring the time per visit is an important metric for the site's usefulness and, to some extent, stickiness and is fully based on the sessions. The time per visit is closely related with the visitors metric. A degree of controversy here may be seen in the fact that the longer time spent on the site can signal its usefulness as well as uselessness because it is difficult to know if the user is happily employing Nonaks's internalisation or combination to the located practical Information or haplessly keeping searching for non-existent answers. Regardless of the scenario, this metric helps assessing the user's commitment because, by definition, no user will stay long on an irrelevant site.

The time between visits is related to returning visitors and reflects the user's commitment even better than the time per visit because any returning always indicates commitment. Apparently, the smaller gaps are between visits, the stronger commitment is but ultimately any number greater than zero demonstrates that there is at least one returning visit and, thus, a degree of commitment. Counting the time between visits does not require the sessions but rather the cookies, the IP address or user registration.

While the above quantitative metrics are easy to implement and analyse for certain statistics, a degree of qualitative analytics is also often required for a comprehensive picture. Some of such qualitative metrics can be in analysing the most visited sections of the site as well as the referrer, search engine, search term and geography details of the user (Jana, S., Chatterjee, S., 2004).

It is always worthwhile to track what sections of the site attract most of the traffic. Based on this the site's operator can see the users' priorities and adjust the site structure and content accordingly. Of course, as with all qualitative metrics, not everything can be directly measured against a numerical scale and so some heuristics must be employed with regard to what comprises a section and how its popularity is to be determined. Page loads and posts are two of the main techniques used for such purposes.

Examining the referrer, or the Web origins of the visiting users, is useful for finding out how the users arrive at this site. In general, coming to any Web resource can be done by 1) direct typing of the target URL, 2) following a link returned from a search engine or 3) following a link from another Web site. Knowing these details will help understanding where the site's audience is coming from and targeting these people better. Whereas new and relatively unknown sites will usually see the referrer in either of the first two categories, popular Web resources have most of their visitors from search engines and existing links.

Since search engines are often the main generators of visitors, scrutinising the second category of referrers can be a separate metric. Search engines can be generic like Google.com or Yahoo.com as well as have localised versions for country-specific searches, e.g., Google.ie or Google.de. There can also be specialised search engines in different areas with some of the most prominent examples being Technorati.com for blog searches and Kelkoo.com for price scans. Aiming at a certain segment of the Web audience may be closely related to finding the right search engine and tweaking the site for achieving best ranking on it. On the other hand, seeing visitors coming from unrelated searches may give some insights as to what other potential the site can have.

Another valuable feature that is extracted from the referrer and based on the search engine metric is search keywords or search terms and it can provide a metric on its own. The fact that a user comes from a search engine is a good indicator of a site's popularity but it does not give answers as to why the user is interested in this particular site or what the user's interest is at all. Examining the search keywords, however, may answer such questions and provide a deeper insight into the positioning and perception of the site.

The last important analytic is the users' geography and it is normally retrieved either from the user's IP address or the referrer location or language. Knowing national and ethnic characteristics of the visiting public may be practical for most serious Web resources but for sites with international versions and multilingual interfaces it can be absolutely critical.

Out of the identified Knowledge attributes, only blogs, communication/feedback means, discussion boards/forums, users' comments and wikis can use the posts metrics. Almost all the attributes can make use of the registered users metric but in reality only the previous set minus communication/feedback means does require the user registration. The rest of the metrics can be equally utilised by all the attributes except for RSS which is slightly specific because it does not always need a browser for its usage and, therefore, does not always provide extended properties like the referrer and the session. Without sessions every page load is effectively the same as a visit and since the proper use of RSS by definition requires frequent updates, any metrics related to visitors or time can not be applicable with page loads and, where possible, geography being the only things to be measured. Also, time per visit can be counted only where the attribute implies more than one page so attributes that can be implemented on a single page, e.g., communication/feedback means or sitemaps, may not be able to avail of it.

It is envisaged that using a combination of these Web metrics on the identified Knowledge attributes can, to some extent, help assessing the value of the Web Knowledge but it must be noticed that, as with any other form of Knowledge, precisely measuring it is rather impossible (Gottschalk, P., 2005; Tiwana, A., 1999). In some cases, it may even be better not to try monitoring or measuring Knowledge at all (Eklundh, K.S., et al., 2002; Rao, M., 2004).

### ***3.3 Attributes***

#### *3.3.1 Blogs*

If even the Web's father Tim Berners-Lee uses blogs to deliver his thoughts to the public, it must indeed be one of the most popular Web technologies at the moment (Berners-Lee, T., 2007). And one of the most Knowledge-related, judging by the number of references in the relevant literature (Alexander, B., 2006; Allen, C., 2004; Lee, M., et al., 2006; Rao, M., 2004).

The term blog is derived from two words Web and log that, when concatenated and then dissected again, can be read as “We blog”. Blogs are in essence electronic public diaries where an author or a group of authors can post their thoughts and visitors can add their comments. Both authors and visitors can normally modify or delete their posts thereby adding dynamism and tacitness. Unlike traditional diaries, however, blog entries are displayed in reverse chronological order so the newest topic is always at the top of the page. The most popular dedicated blog services currently are Blogger (<http://www.blogger.com>), LiveJournal (<http://www.livejournal.com>), TypePad (<http://www.typepad.com>) and WordPress (<http://wordpress.com>) but many prominent Web resources routinely include blogs as a feature on their site, e.g., Guardian newspaper (<http://blogs.guardian.co.uk>), Reuters financial and news services (<http://blogs.reuters.com>), Wall Street Journal (<http://blogs.wsj.com>), Nokia Corporation (<http://blogs.forum.nokia.com>), Chrysler (<http://blog.chryslerllc.com>), European Union portal (<http://blogs.ec.europa.eu>), Dell (<http://www.direct2dell.com>), Yahoo! portal (<http://360.yahoo.com>), MySpace social networking (<http://blog.myspace.com>), Amazon e-commerce (<http://www.amazon.com/gp/daily>).

The main reasons behind the blog popularity are probably in its liberal nature and hyperlinked structure with both features naturally provided by the WWW. As with diaries, writing a blog is a good will and spontaneous action and is based on the author’s motivation without any enforcement from the outside (Allen, C., 2004). Most blogs typically heavily rely on both incoming and outgoing hyperlinking that affected as well as was affected by a whole set of new Web terms and technologies including trackbacks, permalinks, podcasting and RSS (Alexander, B., 2006). Another phenomenon arose in the area of blog searching tools with Technorati being the most prominent one (Boyd, D., 2007; Dotsika, F., Patrick, K., 2006).

Blogs are currently arguably the most influential member of the social software family of technologies and as such they intrinsically support Knowledge and KM processes as demonstrated before. Except for combination which, strictly speaking, requires some form of conversion to a different technology or format, all the other SECI components are catered for by blogs seamlessly. As the name implies, the most important aspect of social software offsprings is socialisation and blogs excel at it being, perhaps, second only to forums. Internalisation and externalisation are also present as they are often



the endpoints of the socialisation part, especially if it happens in an electronic environment such as the Web where everything must be digitised, or externalised, before any further transmission or processing. So in the blog terms, externalisation is writing a blog, internalisation is reading it while socialisation is a mix of both writing and reading. Combination, even though largely missing, can be found in preparing and exposing the blog content for the external world where it can be used by different technologies or converted to other formats and the above mentioned trackbacks, permalinks, podcasting and RSS do provide means for this. Being originally created for Knowledge creation, the SECI cycle is also essential for Knowledge sharing and usage as was shown previously. Therefore, all the core Knowledge processes can be emulated by the blog which confirms its Knowledge value.

It was previously mentioned that blogs together with forums and wikis are the most powerful Knowledge enablers on the Web. They may be used for similar purposes but they do differ in certain aspects such as the conversation mode and content indexing (Kille, A., 2006). While both forums and wikis are many-to-many communication tools, blogs are usually offering one-to-many broadcasting which is obviously more limited. Blogs and discussion forums are both primarily indexed by time but wikis are indexed by topic. This makes blogs and forums more useful for the distribution of time sensitive articles but wikis are apparently more relevant for timeless topical references. Another interesting point is that all of these tools offer equally powerful editing options that allows them to deliver tacit Knowledge in addition to explicit Knowledge that is ubiquitous on the Web. Overall, wikis might appear to be the most versatile for KM applications but each of the three definitely has its beneficial uses (Kille, A., 2006). Blogs can be seen most appropriate for environments with the lowest degree of formality while wikis fitting the opposite end with forums positioned in between. Using blogs for KM purposes is sometimes called “klogging” (Rao, M., 2004). Many corporations started to endorse blogs’ importance by publishing them both on their intranets for internal usage by their employees and public Web sites for communicating with customers (Lu, H., Hsiao, K., 2007).

Blogs can be usually employed in combination with many other Knowledge attributes such as communication/feedback means, experts' reviews, FAQ, news, RSS, search facilities, sitemaps and users' comments and can avail of all of the mentioned metrics.

### 3.3.2 *Communication/feedback means*

Publishing a Web site also implies aiming it at a certain segment of the audience and listening to this audience should be an essential part of the design and deployment of the site. Getting a feedback from the content consumers is effectively sharing their Knowledge with the content producers and it should never be neglected (Eklundh, K.S., et al., 2001; Figallo, C., Rhine, N., 2002; Karayanni, D., Baltas, G., 2003; Rao, M., 2004; Tiwana, A., 1999). The feedback revolves around the user motivation and perception and for the producer it is important to understand both. What type is this feedback (advice, criticism, question) and how it is received is really secondary, the main thing is that it is being obtained and examined on a regular basis. Therefore, it is rather a feature than a dedicated technology and technologies that can be used for this purpose vary from static Web pages with a feedback form that either saves the data in the database or delivers it by email to the already mentioned blogs and forums. It can also be done in the form of online surveys, polls and questionnaires or any other formal or informal communication means (Dotsika, F., Patrick, K., 2006; Herder, P.M., et al., 2003; Lu, H., Hsiao, K., 2007).

Most of the time, however, it is a relatively simple HTML page named similarly to “Contact us” or “Feedback” that is easy to locate and use as can be seen, for example, on LiveJournal (<http://www.livejournal.com/contact>), Chrysler ([https://www.chryslerllc.com/en/contact\\_us/email](https://www.chryslerllc.com/en/contact_us/email)) or Yahoo! (<http://www.yahoo.com/r/1p>) sites. In this form, communication/feedback means can be seen primarily as a Knowledge sharing tool whose usage is always initiated by the customers and as such involves only externalisation and, sometimes, combination processes. Depending on how important the feedback is to the content providers and how the feedback processing is implemented, it may be possible that internalisation and socialisation parts of the SECI cycle can be invoked too, e.g., when blogs or forums are employed for such a purpose, but generally it is safe to consider that only externalisation and, to some extent, combination processes are inherently present in this feature. Because of this uncertainty with the further storage of the feedback, however, it is possible to assume the presence of tacitness here.

Communication/feedback means may often imply a one way process of Knowledge sharing from the customer to the provider so it is unclear if Knowledge creation and usage processes will ultimately be present or not. Therefore, having this feature alone will not make a site an advanced Knowledge node.

With respect to other Knowledge attributes, communication/feedback means can be implemented together with blogs, discussion boards/forums, users' comments and wikis and can rely on all metrics except for registered users (because it may not need registration) and time per visit (because it may well be a single page feature).

### *3.3.3 Discussion boards/forums*

With the roots of its older brother, the Bulletin Board System (BBS), traced back to ARPANET projects of 1970s, the discussion boards or Internet forums can be deservedly called the progenitor of all the modern social software (Allen, C., 2004; Figallo, C., Rhine, N., 2002). And if by popularity the forums might be currently trailing the blogs, by their overall Knowledge value they are most likely the leading Web technology at the moment with the figure well over 300,000 installations and the massive repository of unique and topical Information (Lee, M., et al., 2006; Plant, R., 2004). It is arguably the most advanced and powerful Information and Knowledge sharing technology found on the Web which can be explained by its long history and communal nature. Having been flourishing on the independent and informal Web for many years, forums are now becoming more and more commonplace on corporate and official sites (Elenurm, T., 2004; Karayanni, D., Baltas, G., 2003; Lee, M., et al., 2006). Some of the best examples from both camps can be seen at GSM Arena (<http://www.gsmarena.com/forum/index.php>), Digital Photography Review (<http://www.dpreview.com/forums>), Yahoo! portal (<http://groups.yahoo.com>), MySpace social networking (<http://forums.myspace.com>), European Union portal (<http://forums.ec.europa.eu/debateeurope>), Nokia Corporation (<http://discussion.forum.nokia.com>), eBay Online Marketplace (<http://pages.ebay.com/community/boards>), Adobe Systems (<http://www.adobe.com/support/forums>). The structure and design of forums can be different but all of them provide some form of categorisation and sorting of time-based

topics and posts. Despite possible difficulties with finding the right Information, the forums still provide the best ways to locate it reasonably quickly due to its inherently structured nature. Of course, as with other advanced technologies such as blogs and wikis, forums also routinely provide a built-in search facility. In addition, they also allow for topical browsing which is less confusing and more efficient than in blogs and wikis.

Since forums always imply bi-directional communication of many-to-many, they naturally encompass the entire SECI cycle with socialisation, externalisation combination and internalisation happening similarly to the blog environment. While forums, perhaps due to their respectable age, are not always identified with social software which is a relatively modern phenomenon, they do deliver the highest degree of socialisation among all the other Web technologies. With blogs, normally only one person writes while other involved people read, with wikis many people come to read but only a few interested and knowledgeable write but with forums there is no distinct border between writers and readers as they routinely swap their roles. Why people come to a forum is because they are interested in a subject (similarly to wikis but contrary to blogs where interest is mostly personal). If they look for an answer, before finding it and reading it, they may start asking questions which effectively turns them into writers. Apparently, if they find the answer they may leave for good even without writing a single line but such situations, even though quite possible, do not have a deteriorating effect on the value of the forum resources. But if these people stay, even if only for asking, the forum value will only grow because any questions in a dedicated community stimulates answers. Of course, it again revolves around the user motivation but an interesting Internet phenomenon is that in a free and informal environment people are willing to participate without any external incentives or enforcements (Allen, C., 2004; Figallo, C., Rhine, N., 2002).

Similarly to blogs, externalisation and internalisation are executed when the user transfers Knowledge to the forum or absorbs Knowledge from it. Since forums are much more sophisticated and powerful, combination can also be achieved relatively easily by embedding different formats either in posts directly (e.g., Word or PDF documents) or in specialised sections (pictures in photoalbums).

As the full SECI cycle is shown to be present, it directly confirms feasibility of Knowledge creation and indirectly allows for Knowledge sharing and usage as was shown previously. The potential of the internet forums for Knowledge sharing was highlighted and discussed on many occasions and they appear to be one of the best available Web platforms for Knowledge sharing activities (Chang, Chi-Cheng, 2003; Erickson, T., Kellogg, W.A., 2001; Gottschalk, P., 2005; Gupta, J., Sharma, S., 2004; Lee, M., et al., 2006). Knowledge usage, despite being a more abstract and elusive concept, was also regularly covered in the forums context (Elenurm, T., 2004; Hiner, J., 2008; Kille, A., 2006). Together with blogs and wikis, forums are the best Web mechanisms for conveying tacit Knowledge which is otherwise relatively difficult to map on the Web.

Discussion boards/forums can coexist well with other Knowledge attributes such as communication/feedback means, experts' reviews, FAQ, news, RSS, sitemaps, search facilities and users' comments and can utilise all the usual Web metrics.

#### *3.3.4 Electronic books/journals/references*

This attribute is effectively a Web representation of the librarian Knowledge where different books, journals, newspapers and other reference and learning material converted to electronic form and published online. In fact, as previously mentioned, some of these entities may even originate in electronic format so no further efforts will be needed. It is a controversial topic if the electronic reference material can and should fully replace the paper-based versions but there is no argument about its convenience, availability and accessibility (Alexander, B., 2006; Chiles, A., 2008; Hiner, J., 2008; Sridharan, B., Tretiakov, A., Kinshuk, 2004). Since electronic books/journals/references can be technically in many formats, it is rather a feature than a technology.

It must be noted that this Knowledge attribute is perhaps the only one which, in addition to freely available resources, is also commonly distributed on a paid-for basis. Some of the best known online repositories of this type are Safari Books Online (<http://www.safaribooksonline.com>), Questia Media (<http://www.questia.com>),

Elsevier (<http://www.elsevier.com>) and Scholarly Journal Archive (<http://www.jstor.org>). It may be against the liberal Web principles but it is easy to justify why such digital libraries are charging money: while lending a book in a real library requires returning back the same instance of the physical book, borrowing a digital book effectively leaves it in the borrower's possession due to the simplicity of copying and impossibility of identifying differences between the original and a copy. Therefore, digital borrowing is much more like purchasing than borrowing in traditional terms and a few companies try to capitalise on this principle with some selling exclusively digital books like eBooks digital bookstore (<http://www.ebooks.com>) while others mixing digital content with hardcopies like Amazon e-commerce (<http://www.amazon.com>). Still, there are many independent and free sites, especially within the academic community, with electronically available resources of various quality and value, e.g., Online Library of Literature (<http://www.literature.org>), Great Literature Online (<http://classicauthors.net>), University of Virginia Library (<http://etext.virginia.edu/ebooks>), Digital Photography Review (<http://www.dpreview.com/learn>).

As will all types of the librarian Knowledge, this Knowledge attribute is also largely disconnected from tacit Knowledge and, therefore, out of the four SECI processes only combination can be explicitly located in it. Digitising a hardcopy is probably one of the best possible examples of combination. Implicitly, internalisation is present too because all electronic content ultimately aimed at human consumption. Similarly, creating any fragment of explicit Knowledge, e.g., a book or an article, implies externalisation. Still, Knowledge creation can not be fully done with this attribute alone, though it is very appropriate for the other two core processes of Knowledge sharing and usage.

It must be noted that electronic books/journals/references, despite certain similarities, are different to product documentation/user's manuals in one important aspect: the former provide generic Information on a variety of independent sources while the later usually describe provider-specific products or services on provider-related sites.

This Knowledge attribute can be used with FAQ, Knowledge bases, product documentation/user's manuals and search facilities. It can also be assessed with all of the Web metrics bar posts and, in many cases, registered users.

### 3.3.5 Experts' reviews

It is commonly agreed that one of the best sources of Knowledge is in an expert insight whatever form it takes (Stankosky, M., 2005; Tiwana, A., 1999). It can be provided on expert's own initiative or, more frequently, on request from an interested party (Chang, Chi-Cheng, 2003; Eklundh, K.S., et al., 2001; Karayanni, D., Baltas, G., 2003). Putting the experts' opinion online makes their invaluable Knowledge on the subject available to the general public so it is primarily about Knowledge sharing. Some of the best Web resources with experts' reviews on a variety of products and services are CNET Networks (<http://reviews.cnet.com>), Consumer Search Reviews (<http://www.consumersearch.com>), Digital Photography Review (<http://www.dpreview.com/reviews>), GSMarena (<http://www.gsmarena.com/reviews.php3>), Engadget magazine (<http://www.engadget.com>), Online Review London magazine (<http://www.onlinereviewlondon.com>).

Most of the time the experts are asked for their opinion and might even be paid for providing it so may look against the free nature of the Web and its KM mechanisms. Therefore, externalisation is not governed by the examined here principles but rather by the market forces. In most cases, however, these experts' reviews are nevertheless available on the Web for free so there are no barriers for internalisation. Since the other two SECI processes, socialisation and combination are apparently missing, Knowledge creation appears infeasible with the experts' reviews attribute. Nonetheless, it is a great specimen of Knowledge sharing and usage.

It is important to highlight differences between this attribute and users' comments that both give a third party opinion on a certain subject. While experts' reviews can be dictated by the external forces and, therefore, can suffer from some degree of bias, users' comments are more straightforward because they are always induced by internal

stimuli. Also, in contrast to experts' reviews that can be obtained by any, even offline techniques, users' comments are normally received through communication/feedback means. Sometimes, however, experts' reviews and users' comments can be so closely related that they can not be separated (Chang, Chi-Cheng, 2003; Figallo, C., Rhine, N., 2002).

Experts' reviews is apparently a generic feature rather than a specific technology and on a Web site it can be typically combined with blogs, discussion boards/forums, FAQ, Knowledge bases, news, search facilities and wikis and all of the standard Web metrics, excluding posts and registered users, can be applied to it.

### 3.3.6 *FAQ*

Frequently asked questions (FAQ) is a section of a site that provides answers to some of the most popular questions on the relevant subject. This attribute is also very much about Knowledge sharing between experts and non-experts providing quick shortcuts to essential topical Information (Bergeron, B., 2003; Bramer, M., 2003; Fahey, L., et al., 2001; Karayanni, D., Baltas, G., 2003; Rao, M., 2004). It is a de-facto standard and so can be found on most serious sites, e.g., Nokia Corporation (<http://europe.nokia.com/faq>), European Union portal ([http://europa.eu/abouteuropa/faq/index\\_en.htm](http://europa.eu/abouteuropa/faq/index_en.htm)), Internal Revenue Service (<http://www.irs.gov/faqs>), Mozilla Foundation (<http://www.mozilla.org/faq.html>), Dell (<http://www.delltechcenter.com/page/FAQ>), LiveJournal (<http://www.livejournal.com/support/faq.bml>). Together with sitemaps, FAQ is the main structured entry point into most Web resources because it offers categorisation of the commonly asked and expertly answered questions relevant for a particular Web resource. FAQ does not require any specific technology as it is generally implemented with a number of relatively simple hypertext pages.

Since FAQ is usually quite a static section of the site, it does lack in socialisation. The other three SECI processes can be found in FAQ usage (internalisation) and updates (externalisation and combination). The more dynamic is this section, the better it supports externalisation and combination processes but without socialisation it can not



fully address Knowledge creation, though Knowledge sharing and usage appear to be inherently present.

With respect to other Knowledge attributes, FAQ can be potentially employed in combination with blogs, discussion boards/forums, electronic books/journals/references, experts' reviews, Knowledge bases, product documentation/user's manuals, search facilities, users' comments and wikis. It can also be used with all the metrics except for posts and registered users.

### *3.3.7 Knowledge Bases*

Despite its conflicting definitions, Knowledge base is a feature a lot of organisations tend to declare having in possession (Elenurm, T., 2004; Plant, R., 2004; Rao, M., 2004; Turban, E., Aronson, J.E., 2000). Knowledge base can refer to a database (Bergeron, B., 2003; Waltz, E., 2003), network (Figallo, C., Rhine, N., 2002) or an expert system (Gottschalk, P., 2005) but most of the time it is a combination of all (Gupta, J., Sharma, S., 2004). Today, the term Knowledge base usually means a set of technologies and resources encompassing everything required to get the necessary Information and, thus, Knowledge, on a specific subject. Knowledge bases always have a search facility and an exhaustive repository of relevant material that can include, among others, product documentation, electronic references, frequently asked questions and experts' reviews. Even though Knowledge bases are most often deployed on intranets for internal use, there are many examples when they naturally exist on the Web as, for example, with Nokia Corporation (<http://wiki.forum.nokia.com/index.php/KnowledgeBase>), Apple Computer (<http://kbase.info.apple.com>), Adobe Systems (<http://www.adobe.com/support/knowledgebase>), Corel Corporation (<http://kb.corel.com>).

Perhaps surprisingly, but Knowledge base alone is not sufficient to express all the core Knowledge processes because it lacks efficient communication means and, therefore, can not support socialisation. Even though the other three SECI processes (internalisation, externalisation and combination) can be easily represented with

Knowledge bases, absence of socialisation makes Knowledge creation by and large deficient. Knowledge sharing and usage are still served by Knowledge bases quite well.

Due to its versatile nature, Knowledge base is probably the most ample attribute that can accommodate most of the other explicit attributes including electronic books/journals/references, experts' reviews, FAQ, news, product documentation/user's manuals, search facilities, sitemaps and users' comments. All of the metrics with the usual exception of posts and registered users can be used with Knowledge bases.

### 3.3.8 News

The Web increasingly becomes the number one choice for staying in the know and getting news online is often the most convenient and fast way to stay updated (Potosky, D., 2006; Weaver, A.C., 1998). Be it local or educational news, stock quotes, showbiz, sports or weather, the Internet and the Web promptly deliver all the relevant Information that can be grown into Knowledge in an appropriate environment (Chang, Chi-Cheng, 2003; Rao, M., 2004). Also, many organisations provide relevant news on their sites to enhance their image (Karayanni, D., Baltas, G., 2003). Some examples of such thematic news can be seen at Nokia Corporation (<http://pressbulletinboard.nokia.com>), European Union portal ([http://europa.eu/press\\_room/index\\_en.htm](http://europa.eu/press_room/index_en.htm)) or Dell ([http://www.dell.com/content/topics/global.aspx/about\\_dell/media/press\\_releases/index](http://www.dell.com/content/topics/global.aspx/about_dell/media/press_releases/index)) while generic news services are also abundant on the Web: Guardian newspaper (<http://www.guardian.co.uk>), British Broadcasting Corporation (<http://www.bbc.co.uk>), Cable News Network (<http://www.cnn.com>), Reuters financial and news services (<http://www.reuters.com>). Google News (<http://news.google.com>) and Memeorandum (<http://www.memeorandum.com>) offer another approach by aggregating news from different sources (Alexander, B., 2006).

News is a feature rather a specific technology but there is at least one Web technology, Really Simple Syndication (RSS), which was designed purposely for providing online news updates (Alexander, B., 2006). What RSS essentially does is provide an

exchange protocol to read and feed Web contents remotely so when something relevant added to a host site, all interested clients may get timely updates.

Knowledge creation, as with all purely explicit attributes, is rather non-existent as far as this attribute concerned. Knowledge sharing and usage, however, are served perfectly by explicit attributes and news is no exception. Out of the full SECI cycle, all processes apart from socialisation are supported quite well by this attribute.

News may be used in conjunction with other Knowledge attributes such as blogs, discussion boards/forums, experts' reviews, Knowledge bases, RSS and search facilities and can be analysed with all of the usual metrics minus posts and registered users.

### 3.3.9 *Product documentation/user's manuals*

Life progresses at an ever accelerating rate and more and more areas get, depending on the viewpoint, either enriched or littered with technical jargon which mandates a certain degree of technical literacy. Since the Internet (which actually often implies the World Wide Web) is arguably both the most popular and most universal technology at the moment, it must at least be able to provide Information on its own components and usage. Therefore, it is only natural that the first product documentation, Request for Comments (RFC), was about the Internet itself (Berners-Lee, T., 1996; Russell, A.L., 2006). As the Internet and its multiple subsystems grew in numbers and complexity, the need for documentation grew exponentially eventually encompassing various offline concepts in addition to the core online terminology (Elenurm, T., 2004; Hameri, A.-P., Puitinen, R., 2003; Herder, P.M., et al., 2003; Karayanni, D., Baltas, G., 2003; Potosky, D., 2006). A number of illustrations can be seen on Nokia Corporation (<http://www.forum.nokia.com/main/resources/documentation>), Apple Computer (<http://www.apple.com/support/manuals>), Wall Street Journal (<http://online.wsj.com/wsjhelp/center/main>), Digital Photography Review (<http://www.dpreview.com/reviews/specs.asp>), Dell

(<http://support.dell.com/support/systemsinfo/documentation.aspx>) and Amazon e-commerce (<http://www.amazon.com/gp/help/customer/display.html>) sites.

As noted previously, product documentation is different to electronic books because it addresses certain products as opposed to generic subjects. Product documentation/user's manuals can be located either on the manufacturer's site or in independent Web repositories. Most manufacturers are only happy to give away detailed and extensive documentation to pre-empt customers from contacting their Help Desks and Call Centres.

Similarly to electronic books/journals/references, this is not a technology but rather a feature that is essentially a Web representation of the librarian Knowledge with all its shortcomings, specifically with respect to tacitness. Therefore, the SECI rubric can not close the socialisation gap resulting in Knowledge creation being missing. Knowledge sharing and usage, as with most explicit attributes, is catered for by product documentation/user's manuals.

This Knowledge attribute can be possibly used with electronic books/journals/references, FAQ, Knowledge bases and search facilities. Product documentation/user's manuals can also be assessed with the usual set of metrics bar posts and registered users.

### *3.3.10 RSS*

Really Simple Syndication (RSS) was designed specifically for providing online updates for frequently changing contents (Alexander, B., 2006). What RSS essentially does is provide an XML-based protocol to exchange Information between different Web sites. When the host has something relevant added, the subscribed clients, that periodically poll the host for updates, can get those updates reflected on their sites. RSS is a client-server technology so it needs a server, or a content provider, to operate. In addition to dedicated news sites, most popular content provider services at the moment are blogs, forums and wikis (Dotsika, F., Patrick, K., 2006; Kille, A., 2006; Lu, H., Hsiao, K., 2007; Watson, K., 2007). Some of the RSS examples can be found

at Nokia Corporation (<http://pressbulletinboard.nokia.com/feed>), Guardian newspaper (<http://www.guardian.co.uk/rss>), Google News (<http://news.google.com/?output=rss>), European Union portal ([http://europa.eu/geninfo/info/guide/index\\_en.htm#rss](http://europa.eu/geninfo/info/guide/index_en.htm#rss)), Digital Photography Review (<http://www.dpreview.com/feeds>), Dell ([http://www.dell.com/content/topics/global.aspx/rss/en/rss\\_main](http://www.dell.com/content/topics/global.aspx/rss/en/rss_main)). It is worth noting that there is a new technology, Atom, e.g., Google News (<http://news.google.com/?output=atom>), that can be a successor to RSS because it is providing the same services but at the moment RSS position, judging by the number of influential users, is not in danger (Alexander, B., 2006).

Since RSS is an automated exchange of Information that does not explicitly require the human element and tacitness that comes with it, it does not cover the whole SECI cycle and, therefore, is not quite suitable for Knowledge creation. Only the combination part of SECI can be expressed with the help of RSS. Even Knowledge usage may not be necessarily present due to the fact that this technology can function seamlessly without being ever consumed by anybody, or internalised. Sharing of explicit Knowledge is conducted by RSS perfectly, however.

RSS is often employed simultaneously with blogs, discussion boards/forums, news and wikis but, due to its design and implementation specifics, can be successfully measured only with page loads and geography metrics.

### *3.3.11 Search facilities*

Search facilities are most likely the online champion with regard to popularity and usage, though not necessarily Knowledge-related (Alexander, B., 2006; Potosky, D., 2006; Weaver, A.C., 1998). But their Knowledge value is also hardly disputable since they are often the most efficient way to Knowledge usage on the internal Knowledge systems as well as on the public Web (Chang, Chi-Cheng, 2003; Elenurm, T., 2004; Herder, P.M., et al., 2003; Hiner, J., 2008; Huang, H., Liaw, S., 2001; Rao, M., 2004; Turban, E., Aronson, J.E., 2000). A serious issue for both Knowledge usage and search facilities is in scope and quality of Information available because even the most sophisticated search tools can always return a lot of irrelevant results (Bergeron, B.,

2003; Berners-Lee, T., 1996; Dotsika, F., Patrick, K., 2006; Eklundh, K.S., et al., 2001). A search facility is a technology solution.

Most popular dedicated search engines are Google (<http://www.google.com>), Yahoo! portal (<http://www.yahoo.com>) and Microsoft Network (<http://www.msn.com>) with Google being by far the most dominant. At the same time, the majority of serious sites now routinely incorporate a search facility making it another de-facto standard: Guardian newspaper (<http://browse.guardian.co.uk/search>), Reuters financial and news services (<http://search.us.reuters.com>), Wall Street Journal (<http://online.wsj.com/public/search>), European Union portal ([http://europa.eu/geninfo/query/search\\_en.html](http://europa.eu/geninfo/query/search_en.html)), Dell (<http://search.dell.com>), MySpace social networking (<http://search.myspace.com>).

A search facility is the undisputed number one Knowledge discovery mechanism on the Web so its role for Knowledge usage is difficult to overestimate (Herder, P.M., et al., 2003; Hiner, J., 2008; Rao, M., 2004; Turban, E., Aronson, J.E., 2000). It is also unique to the Web as there is simply no equivalent to its scope and speed in any other, online or offline, area of life (Hiner, J., 2008; Weaver, A.C., 1998). Since Knowledge activities are all about *answers*, a search tool is almost always the first step to get them and as such it can be seen as an entry point to the entire Web Knowledge. It was suggested that two of the main Knowledge-related activities conducted on the Web are problem solving and Information gathering which both require answers and both are perfectly served by a search tool (Hiner, J., 2008). The key thing to remember, however, is that search is simply a gateway to the Web Knowledge or a door to the Knowledge repository and it does not possess any Knowledge per se. Knowledge must exist independently from search tools, without it search can still open a door but the repository will be empty and, thus, of little use or interest. Therefore, despite all its power and pervasion, a search facility alone will not add much Knowledge value to any site if there is no Knowledge already available and accessible for that site. It is important that Knowledge must not necessarily exist on the site in question, following the general hyperlinking principles, it must simply be accessible to it. Some of the best examples of suitable Knowledge repositories for search tools to operate on are blogs, forums, electronic books, Knowledge bases, product documentation and wikis (Chang, Chi-Cheng, 2003; Hiner, J., 2008; Rao, M., 2004).

So out of the three core processes of Knowledge creation, sharing and usage, search tools seem to be catering for the last one only. They do excel at facilitating Knowledge usage but fall short of supporting Knowledge creation and sharing properly. Some contribution to Knowledge creation and sharing can be seen in helping to locate the required Information (for Knowledge creation) and to distribute links to the shared Information (for Knowledge sharing) but, overall, it is clear that the search tools are not self-sufficient Knowledge mechanisms. Only the internalisation part of the SECI cycle can be served by them.

The biggest problem with any search is that its results are never guaranteed to have the expected quality (Bergeron, B., 2003; Berners-Lee, T., 1996; Dotsika, F., Patrick, K., 2006; Eklundh, K.S., et al., 2001). This is mainly because the Web resources are indexed and the results are returned based on some computer algorithms that can not always grasp the real meaning of both the indexed resource and the user's query. A possible solution could be in combination of the algorithmic processing with some valuation and categorisation done by the human that would filter out all irrelevant details (Hiner, J., 2008).

Search facilities are the most pervasive Knowledge attribute that can be used in combination with almost all the remaining ones including blogs, discussion boards/forums, electronic books/journals/references, experts' reviews, FAQ, Knowledge bases, news, product documentation/user's manuals, users' comments and wikis. It can also be assessed with all of the Web metrics with the exception of posts and registered users.

### *3.3.12 Sitemaps*

If search engines are the entry point to the entire Web Knowledge, sitemaps can be one of the main entry points to a specific Web resource. The other two popular entry points to a site are the site's search facility and its FAQ. While search tools are providing unstructured results, sitemaps and FAQ both give a well-structured, topical presentation of the site's content (Karayanni, D., Baltas, G., 2003; Tiwana, A., 1999).

It was noted that the concept of a sitemap can broadly correspond to a Knowledge map, an ontological representation of Knowledge assets and their sources (Rao, M., 2004). A sitemap, or a site index, can be also organised by alphabet but most of the time the organisation is rather semantic as can be seen on Nokia Corporation (<http://www.nokia.com/siteindex>), Reuters financial and news services (<http://www.reuters.com/assets/siteindex>), British Broadcasting Corporation (<http://www.bbc.co.uk/worldservice/sitemap>), Wall Street Journal (<http://online.wsj.com/public/page/sitemap.html>) and Dell (<http://www.dell.com/content/topics/segtopic.aspx/sitemap>) sites.

A sitemap is a feature that can be implemented with a few relatively simple static hypertext pages. Except for providing quick shortcuts for Knowledge usage, it does not apparently have much other Knowledge value. Knowledge sharing can be facilitated only if sitemaps links to some other Knowledge sharing mechanisms like blogs, forums or wikis but a sitemap alone does not manifest much Knowledge sharing and does not directly help with Knowledge creation either. Similarly, no SECI processes can be served by it.

This Knowledge attribute does appear to be relatively weak but it can be quite useful in shortening Knowledge path to other attributes like blogs, discussion boards/forums, Knowledge bases and wikis and can employ all of the Web metrics bar posts, registered users and time per visit.

### *3.3.13 Users' comments*

All sites are designed for people and it is vital to listen to them. While communication/feedback means are used to collect user's feedback for various reasons including for internal use only, users' comments actually confirm that that feedback was important by publishing it online and making it available for all. Showing the users' comments on the Web is effectively sharing their Knowledge with others and it should always be encouraged (Dotsika, F., Patrick, K., 2006; Eklundh, K.S., et al., 2001; Eklundh, K.S., et al., 2002; Figallo, C., Rhine, N., 2002; Karayanni, D., Baltas, G., 2003; Rao, M., 2004; Tiwana, A., 1999). This Knowledge attribute, which can



also be called testimonials, is a feature that is a logical extension of the communication/feedback means one and it can be implemented either in a dedicated section or as a complementing subsection in several topical categories as seen on Guardian newspaper (<http://commentisfree.guardian.co.uk>), Wall Street Journal (<http://online.wsj.com/public/page/letters.html>), Review Centre community (<http://www.reviewcentre.com>), CNET Networks (<http://www.cnet.com>) and Epinions reviews platform (<http://www.epinions.com>) sites.

Despite being similar to experts' reviews, users' comments are more motivation-based and less biased but can also be more confusing and less reliable. When this attribute is considered in its simplest form, i.e., without relying on blogs, forums or wikis, it does not offer Knowledge creation alone. But combining it with communication/feedback means, which is actually done on some sites, e.g., GSMarena (<http://www.gsmarena.com>), does make it a viable Knowledge-generating mechanism. In its simplest form, however, it can express only Knowledge sharing and usage but no Knowledge creation. With respect to the SECI cycle, while internalisation and externalisation can be located in users' comments, socialisation and combination processes are apparently missing.

Users' comments are routinely used with other Knowledge attributes such as blogs, communication/feedback means, discussion boards/forums, FAQ, Knowledge bases, search facilities and wikis. With regard to the metrics, often all of the standard ones can be used with users' comments.

### *3.3.14 Wikis*

Wikis are another major phenomenon of social software that has a deep Knowledge impact (Allen, C., 2004; De Judicibus, D., 2008; Dobson, T., Willinsky, J., 2007; Watson, K., 2007). Named by its creator Ward Cunningham after the Hawaiian term for “quick” and described as “the simplest online database that could possibly work”, wiki is an interactive Web publishing platform that essentially gives its users almost full control over the structure and content of its material (Kille, A., 2006). The best example is, of course, Wikipedia encyclopedia (<http://www.wikipedia.org>) that ranks

among the top impossible public goods (Dobson, T., Willinsky, J., 2007). Perhaps its quality can be sometimes arguable but its immense scope of covered material and scale of participation makes it the most likely number one stop for all but the most critical questions (Hiner, J., 2008; Watson, K., 2007). If blogs are the most popular Knowledge Web technology and forums are the most useful, then Wikipedia is definitely the most famous with its over seven million articles in more than 200 languages and 100,000 edits per day (Alexander, B., 2006; De Judicibus, D., 2008; Dobson, T., Willinsky, J., 2007). In addition to Wikipedia, which is an exemplary generic implementation, there are many other helpful but more thematic cases as can be seen at Nokia Corporation (<http://wiki.forum.nokia.com>), eBay Online Marketplace (<http://www.ebaywiki.com>), Apache Software Foundation (<http://wiki.apache.org>), Mozilla Foundation (<http://wiki.mozilla.org>).

Out of the three major Knowledge-enabling representatives of social software, wikis are probably the most flexible with regard to allowing updates and modifications in everything from their organisation to content (Hiner, J., 2008; Kille, A., 2006). Wikis are all about user modification and can be seen as streams of conversation, revision, amendment, and truncation (Alexander, B., 2006). Therefore, they naturally exhibit the hardest part of the SECI rubric – socialisation, or conversion from tacit Knowledge to tacit again. When a user adds or edits a wiki entity, that entity is not guaranteed to exist much longer than the user's online presence and, thus, it may convey tacit Knowledge when it is read by some one else and then either deleted completely or simply modified again. Of course, adding or editing an entity also manifests externalisation while reading or editing it implies internalisation. Combination is inherently present in wikis as they serve as a publishing or collaboration platform where the content is created from and hyperlinked to different sources. So the entire SECI cycle can be catered for by wikis which confirms its suitability for Knowledge creation and, to some extent, Knowledge sharing and usage. Knowledge sharing is generally quite nicely served by the same SECI framework as was shown before and Knowledge usage is really anything the user intends to do with obtained Knowledge. It is important to note that while blogs and forums are routinely used for Leisure and even Procedural activities, wikis are normally employed for Knowledge activities only, therefore, it can be deservedly called the most Knowledge-related by design.

Wikis are often used in conjunction with other Knowledge attributes such as communication/feedback means, experts' reviews, FAQ, RSS, search facilities, sitemaps and users' comments. Similarly to blogs, discussion boards/forums and users' comments, measuring wikis usage can benefit from the whole set of the Web metrics.

### **3.4 SUMMARY**

The Web as it is now is very flexible and versatile so many non-standard and custom solutions can find their way online but this work only concentrates on the standard features commonly and freely available to all. They are not all obviously Knowledge-related but they are generic as opposed to specific technologies like expert systems that can also be put online and provide a much greater degree of Knowledge value (Bramer, M., 2003; Huang, H., Liaw, S., 2001). A set of 14 Knowledge attributes (Table 3A) was identified and examined with regard to their Knowledge-enabling capabilities in at least one of the core Knowledge processes (Table 2B). A number of the most common Web metrics (Table 3B) was also inspected and their applicability to the located Knowledge attributes was assessed. The provided Knowledge attributes and Web metrics comprise the *Attributive Framework for Assessing Web Knowledge (AFAWK)* that should help classifying the Web resources and measuring their Knowledge value.

#	Attribute	Socialisation	Externalisation	Combination	Internalisation	Knowledge creation	Knowledge sharing	Knowledge usage
<a href="#">1</a>	Blogs	•	•	•	•	•	•	•
<a href="#">2</a>	Communication/feedback means		•	•			•	
<a href="#">3</a>	Discussion boards/forums	•	•	•	•	•	•	•
<a href="#">4</a>	Electronic books/journals/references		•	•	•		•	•
<a href="#">5</a>	Experts' reviews		•		•		•	•
<a href="#">6</a>	FAQ		•	•	•		•	•
<a href="#">7</a>	Knowledge Bases		•	•	•		•	•
<a href="#">8</a>	News		•	•	•		•	•
<a href="#">9</a>	Product documentation/user's manuals		•	•	•		•	•
<a href="#">10</a>	RSS			•			•	
<a href="#">11</a>	Search facilities				•			•
<a href="#">12</a>	Sitemaps							•
<a href="#">13</a>	Users' comments		•		•		•	•
<a href="#">14</a>	Wikis	•	•	•	•	•	•	•

Table 3.3 Knowledge attributes mapped onto SECI and core processes

Only three “power attributes”, blogs, forums and wikis, can provide the comprehensive set of Knowledge capabilities alone and, therefore, make a host site an advanced Knowledge node or a Public Online Knowledge Exchange. It is important to note that the explanation could be in the fact that only these attributes allow for a true multi-directional communication between all the interested parties and thus capture the most elusive part of SECI – socialisation. A relative comparison of these three most Knowledgeable representatives of social software might suggest that wikis are the overall winner in the Knowledge context but in practice all of them have their advantages and applications (Kille, A., 2006). In short, the blogs can be described as the most popular Knowledge Web technology at the moment while the forums are the most useful and the wikis, in particular thanks to the Wikipedia phenomenon, are the most famous.

Nonaka’s SECI rubric (Nonaka, I., Toyama R., Konno, N., 2000) was used to assess the feasibility of Knowledge creation and, to some extent, Knowledge sharing and usage for all attributes with only blogs, discussion boards/forums and wikis scoring points in all 4 SECI categories and with the only attribute scoring no points at all being sitemaps. RSS and search facilities featured one point each with the remaining attributes placed in the middle of the SECI scale with points in 2 to 3 categories.

Socialisation was the most difficult category to achieve on the Web with only blogs, forums and wikis faring well while internalisation, externalisation and combination was commonplace with 10 to 11 attributes providing each. Assuming that the full SECI rubric is mandatory for a proper Knowledge creation process, only the above mentioned “power attributes” exhibit it but if such a requirement is relaxed then any attribute with at least one SECI point can be deemed suitable for Knowledge creation with only sitemaps failing to demonstrate any degree of it. Knowledge sharing and usage, on the other had, are routinely exhibited by most of the examined attributes. A special attention should be perhaps drawn to sitemaps that score nothing on the SECI test but, even without really addressing Knowledge creation or sharing, they can be very useful for Knowledge usage and, therefore, do qualify to be called a Knowledge attribute. Overall, no recommendation or any other suitability or usefulness suggestion can be made with regard to what attributes or combinations of attributes are best because they all have their own meaning and specifics that can complement each other on most Web sites.

#	Attribute	Page loads	Visitors	Returning visitors	Registered users	Posts	Time per visit	Time between visits	Site section	Referrer	Search engine	Search term	Geography
<a href="#">1</a>	Blogs	•	•	•	•	•	•	•	•	•	•	•	•
<a href="#">2</a>	Communication/feedback means	•	•	•		•		•	•	•	•	•	•
<a href="#">3</a>	Discussion boards/forums	•	•	•	•	•	•	•	•	•	•	•	•
<a href="#">4</a>	Electronic books/journals/references	•	•	•			•	•	•	•	•	•	•
<a href="#">5</a>	Experts' reviews	•	•	•			•	•	•	•	•	•	•
<a href="#">6</a>	FAQ	•	•	•			•	•	•	•	•	•	•
<a href="#">7</a>	Knowledge Bases	•	•	•			•	•	•	•	•	•	•
<a href="#">8</a>	News	•	•	•			•	•	•	•	•	•	•
<a href="#">9</a>	Product documentation/user's manuals	•	•	•			•	•	•	•	•	•	•
<a href="#">10</a>	RSS	•											•
<a href="#">11</a>	Search facilities	•	•	•			•	•	•	•	•	•	•
<a href="#">12</a>	Sitemaps	•	•	•				•	•	•	•	•	•
<a href="#">13</a>	Users' comments	•	•	•	•	•	•	•	•	•	•	•	•
<a href="#">14</a>	Wikis	•	•	•	•	•	•	•	•	•	•	•	•

Table 3.4 Knowledge attributes with relevant Web metrics

Only page loads and geography can be measured with all the attributes. “Power attributes” and user’s comments are the only Knowledge attributes to allow for all

twelve of the described metrics while RSS is exposed only to two universal ones -- page loads and geography. Quantitative metrics can generally translate well into computer algorithms that can in turn be likened to explicit Knowledge but qualitative metrics often require human analytics that can be associated with the tacit component and so the combination of both appears the most comprehensive approach (Hiner, J., 2008). It is worth noting, however, that, according to Albert Einstein, what can be measured is not always important and what is important cannot always be measured and his observation is especially true in the Knowledge context (Tiwana, A., 1999).

Usually, applying metrics also implies some form of benchmarking, i.e., what are the target objectives for the metrics in question, but locating and defining such targets requires a thorough analysis of the application area which is beyond the scope of this work. The provided metrics are only a suggestion for what can be measured and analysed but the question how to interpret the results must be answered depending on the circumstances specific for each case. For example, 100 visitors per week may be a considerable success for a small, niche resource but a clear failure for an industry leader's site. Similarly, a large proportion of visitors from Europe may be the desired results for sites located in or targeting the European markets but a disaster for resources aimed at American or Asian customers.

## 4 REALITY CHECK

*“The knowledge of the world is only to be acquired in the world, and not in a closet.”*  
Lord Chesterfield

### 4.1 Case Studies

#### 4.1.1 Leisure Site: MySpace

MySpace (<http://www.myspace.com>) is a leading name in social networking and is among top ten most popular sites according to Alexa index ([http://www.alexa.com/data/details/traffic\\_details/myspace.com](http://www.alexa.com/data/details/traffic_details/myspace.com)). This site was launched in 2003 as a competitor to the then leader in social networking Friendster and was growing in popularity ever since (Boyd, D. 2007). It was holding steadily to number 6 in Alexa ranking in November and December 2007 but climbed to number 5 in March 2008 that makes it the most visited social site at the moment. It is primarily a Leisure resource with a certain Procedural aspect attached.

Being the illustrative representative of the social software class, MySpace naturally encompasses many of its technologies with only wikis missing from the “power attributes” identified before. Blogs (<http://blog.myspace.com>) and forums (<http://forums.myspace.com>) are both present and, therefore, the site qualifies to be an advanced node or POKE even any further consideration. Taking into account that the human participation, i.e., socialisation, is extremely high, MySpace is clearly very suitable for tacit activities.

Communication/feedback means  
(<http://www.myspace.com/index.cfm?fuseaction=misc.contact>), FAQ  
(<http://www.myspace.com/index.cfm?fuseaction=misc.faq>), news  
(<http://news.myspace.com>) and RSS (<http://news.myspace.com/frontpage/rss.xml>) can also be easily located on the site. Search facilities and users' comments do not have a specific URL as they are accessible either from any age (search facilities) or from the users' profile pages (users' comments). But an advanced search facility for locating people on the site is also available (<http://search.myspace.com>). MySpace provides experts' reviews on a number of subjects including technology (<http://news.myspace.com/technology/electronicreviews>) and books

(<http://news.myspace.com/entertainment/books>) so, except for the above mentioned wikis, only electronic books/journals/references, Knowledge Bases, product documentation/user's manuals and sitemaps are the missing Knowledge attributes from the AFAWK rubric.

Since MySpace is a Leisure resource, it has a lot of features that are not very relevant for Knowledge activities but because it does possess two “power attributes” and a few other Knowledge characteristics, it can be deemed as a suitable for certain Knowledge activities, especially those relying on socialisation. Ultimately, such a large volume of people willing to socialise and share their opinions, however useless they might be, should not be underestimated from the KM point of view (Alexander, B., 2006; Dobson, T., Willinsky, J., 2007; Patrick, K., Dotsika, F., 2007).

#### *4.1.2 Procedural Site: Amazon*

Amazon (<http://www.amazon.com>) was started in 1995 as a Web bookseller but grew to such an extent that it became synonymous to the concept of online shopping which is proved by Alexa ranking ([http://www.alexa.com/data/details/traffic\\_details/amazon.com](http://www.alexa.com/data/details/traffic_details/amazon.com)) where it is placed above all the other online competitors, with the only exception of eBay auctions but they do not quite compete directly, in the cosy Top 50 (Figallo, C., Rhine, N., 2002; Weaver, A.C., 1998). It is apparently a Procedural site but its Knowledge features are definitely worth noting.

Amazon is famous not only for its wide range of merchandise but also for insightful descriptions and comments on its products (Tiwana, A., 1999). Therefore, a big degree of visitors can probably be on the site to investigate the background of a product rather than to buy the actual item. This is another example that proves that measuring Web activities, as opposed to simple visits, can be impractical.

With regard to “power Knowledge attributes”, Amazon does appear to have all of them but in a bit specific form. Blogs (<http://www.amazon.com/gp/daily>) and wikis (<http://amapedia.amazon.com>) have dedicated URLs but they do not appear heavily



advertised and used and locating them on the site is difficult. The discussion boards/forums attribute is even less usable as it is in the beta stage and does not seem to be much utilised either. It is called Customer Discussions Beta and it can be found at the bottom of the page for all available items.

Communication/feedback means (<https://www.amazon.com/gp/help/contact-us/general-questions.html>), electronic books/journals/references (<http://www.amazon.com/e-Docs-Books/b?node=551440>), FAQ (<http://www.amazon.com/gp/help/customer/display.html?nodeId=13685641&qid=1206835440>) and product documentation/user's manuals (<http://www.amazon.com/gp/help/customer/display.html>) can be found on Amazon site but not all easily. RSS (<http://phx.corporate-ir.net/phoenix.zhtml?c=176060&p=newsRSS>) and news (<http://phx.corporate-ir.net/phoenix.zhtml?p=irol-mediaHome&c=176060>) appear to be hosted on external sites and, similarly to the previous set of attributes, they are relatively difficult to discover. Amazon also provides experts' reviews (<http://www.amazon.com/gp/feature.html?docId=1000208301>) but it does not look like a regular service or feature. Similarly to MySpace, search facilities and users' comments do not have a specific URL as they are accessible either from any page (search facilities) or from the products' pages (users' comments). Also, users' comments can be found on a quite useful section of Amazon site -- AskVille (<http://askville.amazon.com>). It is a place where users can ask questions, not always even related to Amazon services, and other knowledgeable people provide answers. Despite having no direct match in the AFAWK rubric, this feature is apparently very Knowledge-relevant and it can be linked to users' comments as well as likened to forums by its nature and blogs by its structure. There does not appear to be a generic sitemap on Amazon but there is a similar product directory page (<http://www.amazon.com/gp/site-directory>) and a real sitemap on the Business Solutions site (<http://www.amazonservices.com/sitemap>).

It is interesting to note that Amazon together with eBay pioneered the idea of public online business exchanges that naturally translate into the examined Public Online Knowledge Exchange (POKE) concept (Figallo, C., Rhine, N., 2002).

Overall, Amazon can technically satisfy the POKE criteria because it does offer blogs and wikis that alone can turn a site in an advanced Knowledge node. An under-developed and under-advertised status of these attributes, however, heavily impairs its socialisation and, thus, Knowledge creation capabilities. Another negative aspect is in its rather poor navigability where most of the attributes can not be easily unearthed. Amazon is a commercial organisation and as such it does not offer much for free so while users' comments can be freely examined, its electronic books/journals/references are sold and, therefore, not easily available for most visitors. On the good note, its search facilities and users' comments are truly exemplary and there are many exceptional usability enhancements that make commercial experience with Amazon quite pleasant. Still, with the identified metrics and some relevant benchmarking, it may well fall behind many of the other popular resources, even in the Procedural category.

#### *4.1.3 Knowledge Site: Yahoo*

Yahoo (<http://www.yahoo.com>) is firmly holding to the number 1 position ([http://www.alexa.com/data/details/traffic\\_details/yahoo.com](http://www.alexa.com/data/details/traffic_details/yahoo.com)) in Alexa Global Top 500 of most popular Web resources. Yahoo was born in 1994 from the catalogues of Web links collected and maintained by its creators and was officially launched next year. Even though it is technically a portal with vast catalogues of indexed resources, for most Yahoo was always primarily the industry leading search engine (Stumme, G., Hotho, A., Berendt, B., 2006; Weaver, A.C., 1998). Up until the arrival of today's leader Google, Yahoo was the first place to look for answers on the Internet. But it also remains a very diversified company offering email, chat, news, weather, auctions and many more free and paid-for services. Yahoo was one of the first companies to realise the commercial potential of the World Wide Web with the idea of selling online services rather than goods (Figallo, C., Rhine, N., 2002; Rao, M., 2004). It was also an early precursor to today's social sites offering a personalised page for all of millions of its users (<http://my.yahoo.com>) (Tiwana, A., 1999). Its major orientation can be described as providing Knowledge activities and its minor is in Leisure as well as Procedural activities.

Yahoo currently has several blogs services with Yahoo 360° (<http://360.yahoo.com>) being the main one. Yahoo blogs are quite numerous but they can not compete with the leaders and another attempt at tipping the scales was Mash unveiled in the end of 2007 (<http://mash.yahoo.com>). Both Yahoo 360° and Mash are much more than just blogs incorporating a big array of features commonly found on social networking sites but judging by their protracted beta statuses they may never fully develop into something really useful or popular. Discussion boards/forums are implemented on the site as Yahoo Groups (<http://groups.yahoo.com>). Except for its structure, the main difference with traditional Web-based forums is in the delivery method where every post on Yahoo Groups is published on the Web as well as forwarded to the participants by email. This can somehow affect tacitness of the online communication as some Information may be forcibly persistent beyond the intentional validity period but generally Yahoo Groups offers a very good level of socialisation.

Communication/feedback means (<http://www.yahoo.com/r/1p>), electronic books/journals/references ([http://dir.yahoo.com/arts/humanities/literature/electronic\\_literature](http://dir.yahoo.com/arts/humanities/literature/electronic_literature)), news (<http://news.yahoo.com>), product documentation/user's manuals ([http://help.yahoo.com/l/us/yahoo/helpcentral/tutorials\\_index.html](http://help.yahoo.com/l/us/yahoo/helpcentral/tutorials_index.html)), RSS (<http://news.yahoo.com/rss>), search facilities (<http://search.yahoo.com>), sitemaps (<http://everything.yahoo.com>) -- they all can be found on Yahoo site quite easily. The best implementation of the users' comments attribute appears in Yahoo Answers (<http://answers.yahoo.com>) which is similar to Amazon AskVille. Experts' reviews are given on various subjects on Yahoo portal, e.g., health (<http://health.yahoo.com/experts>), finance (<http://finance.yahoo.com/expert/index>), movies (<http://uk.movies.yahoo.com/movie-reviews>), sports (<http://sports.yahoo.com/nfl/expertscorner>). FAQ sections are also commonplace (<http://search.yahoo.com/instant/faq>, <http://docs.yahoo.com/docs/info/faq.html>, <http://dir.yahoo.com/Reference/faqs>).

The portal does seem to be a very comprehensive platform for Knowledge activities with Knowledge Bases and wikis being the only AFAWK attributes missing. Blogs and forums, regardless of their questionable implementation, do allow the site to be called an advanced Knowledge node but with additional services like chats and Instant

Messaging provided by Yahoo its Knowledge value gets even higher. The company is always on the lookout for new opportunities and tries to incorporate many of the popular technologies, including social software tools, into its portal as well as add new promising sites to its already impressive portfolio (Alexander, B., 2006; Dotsika, F., Patrick, K., 2006). All this suggests that, intentionally or unintentionally, but Yahoo does provide a great environment for the Web Knowledge.

#### *4.1.4 Major Knowledge Management Resources*

It is worth examining some of the most prominent KM resources in the AFAWK context. BRINT Institute (<http://www.brint.org>), Gurteen Knowledge Website (<http://www.gurteen.com>), David Skyrme Associates (<http://www.skyrme.com>) and Sveiby Knowledge Associates (<http://www.sveiby.com>) can be good examples as they are often referenced and mentioned in mainstream KM literature and discussions.

BRINT (Business Research in INformation and Technology) Institute (<http://www.brint.org>) is run by respected KM practitioner Yogesh Malhotra and it perhaps the most comprehensive Knowledge resource on the Web (Figallo, C., Rhine, N., 2002; Gottschalk, P., 2005; Gupta, J., Sharma, S., 2004; Stankosky, M., 2005; Turban, E., Aronson, J.E., 2000). In fact, there are several additional domains used by the Institute simultaneously (<http://www.brint.com>, <http://www.brint.net>, and others) but here it will be considered as one resource.

BRINT does have one “power attribute” -- discussion boards/forums that appears quite popular with more than 100,000 members (<https://www.brint.net/forums>). Communication/feedback means (<https://www.brint.net/contact.html>), FAQ (<http://www.brint.com/help.htm>), news (<http://news.brint.com>), search facilities (<http://portal.brint.com>) and users' comments (<http://www.brint.com/opinion>) can also be found on BRINT. There is no dedicated URL for electronic books/journals/references as they are literally everywhere on the site. Having the forums attribute effectively makes it a POKE and, overall, the site is an excellent and useful KM portal but its usability and navigability is not among the best.

Gurteen Knowledge Website (<http://www.gurteen.com>) is managed by David Gurteen and is very popular among the online KM community (Huang, H., Liaw, S., 2001). It has a blog (<http://www.gurteen.com/gurteen/gurteen.nsf/id/knowledge-log>), communication/feedback means (<http://www.gurteen.com/gurteen/gurteen.nsf/ConsultancyRequest>), news (<http://www.gurteen.com/gurteen/gurteen.nsf/id/whats-new>), RSS (<http://www.gurteen.com/gurteen/gurteen.nsf/id/rss-feeds>) and search facilities (<http://www.gurteen.com/gurteen/gurteen.nsf/id/gcse>). It also has a Google discussion group (<http://groups.google.com/group/gurteen>) that can be considered as a discussion board or forum but it is difficult to locate so this attribute is excluded from the site's tally. The only "power attribute", blog, does not have much participation and, therefore, the site does not appear to be facilitating a good degree of socialisation and Knowledge creation, even though technically it can be deemed an advanced Knowledge node. Similarly to BRINT Institute, Gurteen Knowledge site also has glaring usability and navigability issues.

David Skyrme Associates (<http://www.skyrme.com>) is offering KM consultancy services and is a recognised expert in this area (Figallo, C., Rhine, N., 2002; Hicks, R., Dattero, R., Galup. S., 2007; Rao, M., 2004; Stankosky, M., 2005; Tiwana, A., 1999; Turban, E., Aronson, J.E., 2000). There are blogs (<http://www.skyrme.com/weblog/kblog.htm>), communication/feedback means ([http://www.skyrme.com/dsa/form\\_enq.htm](http://www.skyrme.com/dsa/form_enq.htm)), electronic books/journals/references (<http://www.skyrme.com/pubs>), FAQ (<http://www.skyrme.com/resource/faqs.htm>), news (<http://www.skyrme.com/site/whatsnew.htm>), search facilities (<http://www.skyrme.com/site/search.htm>), sitemaps (<http://www.skyrme.com/site/sitemap.htm>) and users' comments (<http://www.skyrme.com/services/kudos.htm>) attributes on the site. Even though the blog presence makes this node an advanced one, it does lack in participation and, therefore, in socialisation and full-featured Knowledge creation. It is very well designed and managed, however, so there are no usability and navigability issues common to many known KM resources.

Sveiby Knowledge Associates (<http://www.sveiby.com>) is a company of Karl-Erik Sveiby who is one of the most famous KM pioneers and practitioners (Holsapple,

C.W., Joshi, K.D., 2002; Nonaka, I., Toyama R., Konno, N., 2000; Rao, M., 2004; Stankosky, M., 2005; Tiwana, A., 1999). Electronic books/journals/references (<http://www.sveiby.com/TheLibrary/tabid/68/Default.aspx>) and FAQ (<http://www.sveiby.com/TheLibrary/FAQs/tabid/85/Default.aspx>) can be easily located on the site, search facilities are also available on every page but no other Knowledge attribute seems to be present. The site appears very professional but apparently its Knowledge content is quite low.

Yogesh Malhotra, David Gurteen, David Skyrme, Karl-Erik Sveiby – they all are very credible names in KM and they all work with KM professionally but their sites differ significantly. Yogesh Malhotra and David Gurteen do not seem to be making money from their sites and, therefore, the sites have very practical resources but using them successfully can be difficult due to their design. On the other hand, David Skyrme and Karl-Erik Sveiby have very professionally looking and usable sites that the authors obviously use to earn their living. But if David Skyrme’s site in addition to usability has a lot of Knowledge attributes, Karl-Erik Sveiby keeps his resource very minimalistic being the only examined site failing a POKE test on the AFAWK rubric. Overall, David Skyrme Associates can suit KM beginners with its good interface and useful introductory material while BRINT Institute and Gurteen Knowledge Website with their comprehensive references and catalogues appear more appropriate for experienced and persistent KM professionals.

#### ***4.2 Experimental site***

An experimental site, PanEurope (<http://www.paneurope.eu>), was designed and put online specifically for the purpose of this study. Since language is a major barrier for Knowledge work on the Web (De Judicibus, D., 2008), this site was created in two most popular languages in Europe, English (<http://www.paneurope.eu/en>) and Russian (<http://www.paneurope.eu/ru>), with every section available in both versions. It is important to note that it was a Knowledge site as opposed to a KM one with the difference being that Knowledge sites facilitate Knowledge activities regardless of the area they are conducted in while KM sites concentrate on Knowledge Management as the application area. The experimental site was targeted at European habitants and

visitors covering most important aspects of their daily lives with a dedicated section for 48 European countries or locations. It is important to note that the site was first of all meant to be a working prototype rather than an exemplary implementation. Also, the purpose of this experiment was to demonstrate the feasibility of the idea and not to prove its universal applicability. The idea in question was that Knowledge side of the Web attracts a lot of attention and PanEurope, positioned as a Knowledge resource and designed according to the AFAWK framework, was crafted to test the public perception of a brand new Knowledge node on the Web.

The site has discussion boards/forums (<http://www.paneurope.eu/app/mbbs/en>), search facilities (<http://www.paneurope.eu/en/search.htm>) and sitemaps ([http://www.paneurope.eu/en/about\\_sitemap.htm](http://www.paneurope.eu/en/about_sitemap.htm)) that are easy to locate and use. News are provided both on the generic site level (<http://www.paneurope.eu/en/news.htm>) and location-specific levels. Electronic books/journals/references as well as experts' reviews and users' comments are meant to be on the country level only. The links above are from the English version, the Russian language equivalents have /en replaced with /ru in their URL.

Since its launch in July 2007, there were more than 1800 visitors on the site by the end of March 2008, but only three registered users with no active participation so far. It can be considered a good result for a site created from scratch and with no dedicated budget or support. Moreover, for a Web resource with practically no contents, regular visits from best search engines like Google or Yandex can be a real success. Of course, the content will be eventually added so the site has a potential to become even more popular.

### **4.3 Surveys**

#### *4.3.1 What you come here for?*

This survey was conducted between March 2007 and February 2008 on 7 international Web forums to gauge what motives drive people to the Web. Multiple selections were allowed.

<b>What you come here for?</b>	<b>Votes</b>	<b>%</b>
Information	249	24
Knowledge	141	14
Fun	229	22
Killing time	232	23
Don't know	68	7
Other	106	10
<b>Total voted/votes</b>	<b>566/1025</b>	<b>100</b>

Table 4.1 Survey results: What you come here for?

Assuming that Information and Knowledge belong to Knowledge activities while Fun, Killing time, Don't know and Other all denote Leisure activities, the ratio 38/62 gives a good indication that Web forums do have a high Knowledge content, even if it is twice less than the Leisure one. As was previously noted, Leisure activities are still by far prevailing online. Except for proving the Knowledge worth of the discussion boards/forums attribute, the results suggest that people see the whole Web rather than just forums as a good Knowledge environment because the question “What you come here for?” could also be interpreted as referring to coming online in general instead of visiting specifically the Web forums. Procedural activities were intentionally excluded from this survey as their share is anticipated to be minimal.

#### 4.3.2 *Why you personally need the WWW?*

The second survey running from September 2007 to February 2008 had the question “From the point of view of importance, why you personally need the WWW?” It was shown on 10 international forums as well as on two versions, English (<http://paneurope.eu/app/mbbs/en/forums/thread-view.asp?tid=1>) and Russian (<http://paneurope.eu/app/mbbs/ru/forums/thread-view.asp?tid=1>), of the experimental site. Since the question implied making a choice between the three main online activities, only one selection was allowed.



<b>Reasons to go online</b>	<b>Activity type</b>	<b>Votes</b>	<b>%</b>
For answers	Knowledge activities	53	45
For transactions	Procedural activities	11	9
For everything else	Leisure activities	54	46
<b>Total voted</b>		<b>118</b>	<b>100</b>

Table 4.2 Survey results: Why you personally need the WWW?

The main problem here was in limiting the answer to only one choice as most visitors routinely complained they need to combine these activities and can not easily select only one. The idea behind a single selection mode was to measure the importance of each option in a hierarchical way which is not possible with multiple selections where several options may be selected simultaneously. The participation was lower than in the first survey and the results were slightly different with Knowledge and Leisure activities having almost the same share of votes. In contrast, the first survey showed an almost two-fold dominance of Leisure activities. As anticipated in the first survey, this one confirmed that Procedural activities are still lagging behind with around one-fifth of votes comparing to each of the main activities.

#### 4.3.3 Knowledge retrieval mechanisms on the Web

The last survey was trying to measure the users' perception of the identified Knowledge attributes. It was conducted from November 2007 to February 2008 on 8 international forums as well as on two versions, English (<http://paneurope.eu/app/mbbs/en/forums/thread-view.asp?tid=2>) and Russian (<http://paneurope.eu/app/mbbs/ru/forums/thread-view.asp?tid=2>), of the experimental site. Multiple selections were allowed.

#	Mechanism	Votes	%
1	Blogs	10	4
2	Communication/feedback means	6	2
3	Discussion boards/forums	30	13
4	Electronic books/journals/references	22	9
5	Experts' reviews	23	9
6	FAQ	21	8
7	Knowledge Bases	14	6
8	News	25	10
9	Product documentation/user's manuals	15	6
10	RSS	8	3
11	Search facilities	30	12
12	Sitemaps	4	2
13	Users' comments	16	6
14	Wikis	25	10
	<b>Total voted/votes</b>	<b>50/249</b>	<b>100</b>

Table 4.3 Survey results: Knowledge retrieval mechanisms on the Web

The clear leaders are discussion boards/forums and search facilities with news and wikis sharing the second place. The two main surprises here were in an unexpectedly good value attached to news and a similarly unexpected low position of blogs. The explanation of the news performance may be due to the fact that nowadays most participants use the online media to stay up-to-date instead of more traditional sources like the newspapers, TV and radio. The poor score of blogs can be probably explained by their informal and leisure nature that does not always associate with Knowledge which may be perceived as a serious concept. All the other results are in line with the analysis performed on every feature in the previous section. Another important outcome of the survey is that people in their majority were prepared to see the WWW as a Knowledge environment and were not surprised by the question and its attributes.

#### **4.4 Summary**

The devised AFAWK framework was tested on a number of sites of various orientation. Procedural, Leisure and Knowledge sites as well as major KM resources and an experimental site were examined.

#	Attribute	MySpace	Amazon	Yahoo	Brint	Gurteen	Skyrme	Sveiby	PanEurope
<a href="#">1</a>	Blogs	•	•	•		•	•		
<a href="#">2</a>	Communication/feedback means	•	•	•	•	•	•		
<a href="#">3</a>	Discussion boards/forums	•		•	•				•
<a href="#">4</a>	Electronic books/journals/references		•	•	•		•	•	•
<a href="#">5</a>	Experts' reviews	•	•	•					•
<a href="#">6</a>	FAQ	•	•	•	•		•	•	
<a href="#">7</a>	Knowledge Bases								
<a href="#">8</a>	News	•	•	•	•	•	•		•
<a href="#">9</a>	Product documentation/user's manuals		•	•					
<a href="#">10</a>	RSS	•	•	•		•			
<a href="#">11</a>	Search facilities	•	•	•	•	•	•	•	•
<a href="#">12</a>	Sitemaps		•	•			•		•
<a href="#">13</a>	Users' comments	•	•	•	•		•		•
<a href="#">14</a>	Wikis		•						

Table 4.4 Knowledge attributes on sample sites

The only attribute present everywhere was search facilities and the only attribute missing from all sites was Knowledge Bases. The popularity of the former needs no explanation but the obscurity of the latter appears to make sense too. Searching for answers is one of the most generic online procedures and no site can be deemed practical without it. Knowledge Bases, on the other hand, were described as the most ample feature that usually comprises of a number of other features and technologies. Because of this generality, Knowledge Bases are quite difficult to locate unless they are explicitly called with this name. Therefore, the idea of Knowledge Bases where a search facility operates on a repository of relevant material can be present on many resources but since none of the examined sites declared its presence explicitly, Knowledge Bases scored nil in this test. Still, their Knowledge usefulness should not be discarded because of this as the next worse score went to wikis that are an undisputed “power attribute” Knowledge-wise.

The experimental site partially implementing the Attributive Framework for Assessing Web Knowledge was put online to measure the users’ perception of a Knowledge resource created from scratch. Despite being only a working prototype at the moment,

it already attracts regular visitors and has a potential of growing into a very useful and popular site.

Three surveys were conducted to ask the users directly what they think of the Knowledge side of the Web and their response was largely positive. In some cases, Knowledge activities appear to be competing on par with Leisure activities and all of the 14 identified Knowledge attributes got a sign of approval from the public, perhaps only with a small deviation from the expectations.

## 5 CONCLUSIONS

*“Knowledge is an unending adventure at the edge of uncertainty.”*  
Jacob Bronowski

### ***5.1 Achievements***

The first important aspect of this work was to show that there is a new form of Knowledge emerging and this Knowledge has the World Wide Web as its main habitat. Based on the common characteristics and the working definitions, a thorough analysis was conducted comparing the traditional forms of Knowledge (librarian, educational and organisational) with the new Web Knowledge with their main differences and similarities highlighted. Working definitions included Knowledge itself and its core processes and these concepts were used throughout the work as supporting axioms for putting forward the Web Knowledge statements.

Most of the time KM was only considered in the formal and structured frameworks but this study attempted to show that informal and unstructured environment are also suitable for KM activities. Lack of control and monitoring is a definite obstacle for the Web activities but Knowledge Management, as expressed by the core Knowledge processes, appears to be feasible online.

An in-depth examination of the Web was performed with both its major historical developments and most promising future trends covered. Three categories of Web activities (Procedural, Leisure and Knowledge) were located and carefully inspected. It was found that Leisure category is dominant with Knowledge one being close second but also that they routinely overlap and it would be very difficult to find a site belonging to one category only.

To measure a Knowledge degree of a site, the Attributive Framework for Assessing Web Knowledge (AFAWK) was devised and deployed. A set of 14 Knowledge attributes is the fundamental concept of the framework and it was extracted from an extensive research of prominent Web resources. A supporting set of 12 metrics was offered to measure the Web performance of the identified attributes. An application of the framework to 3 industry leading sites from different categories as well as 4 KM

resources and an experimental site was demonstrated. All except for one Knowledge attribute were successfully located in at least one of the analysed sites and the explanation why the missing attribute was deficient was provided.

A number of online surveys were conducted and they largely confirmed both the importance of Knowledge activities and the validity of the chosen Knowledge attributes. More than 700 users took part in the surveys on several international forums since March 2007 to February 2008.

Lastly, a brand new site, positioned as a Knowledge resource, was published online and its usage was monitored. The site implemented half of the AFAWK attributes and, despite being primarily only a prototypical template rather than a full-featured resource, attracted almost 2000 visitors since its launch in July 2007. One interesting fact worth mentioning is that the site draws hits from popular search engines even without much content.

It was suggested that Knowledge and the Web are mutually dependent (Turban, E., Aronson, J.E., 2000) and this work demonstrated the validity of this yet again.

## ***5.2 Observations***

The Web is constantly changing but its Knowledge constituent stays, and even grows with time. It affects the visitors as their role also changes from being a simple observer to a proactive participant that ultimately affects how the Web is developing. The immense possibilities of the Web turn the consumers into prosumers and they expand these possibilities even further. Old technologies like bulletin boards evolve into Web forums and, together with the new kids on the block such as blogs and wikis, pave the way to the mysterious but still promising paradigm of Web 2.0 that suggests even better opportunities for leveraging the World Wide Web as a Knowledge medium. The Semantic Web also still looks appealing, even if its father now calls it with another pompous TLA – GGG. It is not quite clear yet if tomorrow's Web will be World Wise Web or World Wild Web but chances that its Knowledge value will not diminish look great at the moment. Computers free people from routine tasks offline

and give them more and more time to spend on the Web that results in an unprecedented dedication and motivation to do some other routine tasks, this time online. Both dedication and motivation are the key factors for the unregulated and unlimited Web ecosystem and with their help people can start doing not only useless tasks but also some useful activities, even if unintentionally. This is exactly how the best representatives of social software work – they are normally seen and used as a non-serious tools but that often results in accumulating great repositories of Web Knowledge that can be invaluable for many professionals. This Knowledge is compiled and tested by the masses and available for free for those who can find it. After all, the Web is free and so must be all its components including Knowledge.

But there are problems on the Web, too. Knowledge is definitely there but finding it may not be worth it as despite the pervasive reach of the almighty Google and its suite, vast majority of Web resources is still not covered by search engines and even when it is, the ranking or priority may be gravely irrelevant. Quality of the found Knowledge is also difficult to check even if it is coming from trustworthy sources. Differentiating Knowledge from Information is another Web challenge as most explicit Knowledge residing on the Web can be perfectly legitimately interpreted as Information and vice versa. Interestingly, in stark contrast to their confusing usage on the Web, “Information overload” is never confused with “Knowledge overload”, perhaps because there is never too much Knowledge. Also, despite the fact that technologies are becoming simpler to use and people are becoming more educated, learning the Web itself can be tricky for certain categories of users so the question of leveraging it for something, including Knowledge activities, may never even arise.

If the Web is an ample concept, Knowledge is universally abstract and elusive so studying and properly using it is not any easier. Thanks to its many conflicting and ambiguous definitions in the KM context, the most correct and reliable way of applying Knowledge is probably decided by the needs and background of its bearer or Knower because, ultimately, neither Knowledge, nor KM can really exist beyond the scope of the Knower. On a positive note, however, Knowledge and the Web do appear related, if not mutually dependent. The Web attracted people and those people synthesised Knowledge and ignited KM processes.

### ***5.3 Future Work***

This work covered a number of aspects of the Knowledge-Web relationship but there are still quite a few areas for further investigation with the quality issue being probably the main one (Huang, H., Liaw, S., 2001). The Web will most likely contain the sought Knowledge but without any guarantee with regard to its quality. Since the Web is free and uncontrolled, everybody may contribute but nobody may be willing or able to do a quality control. A possible solution can be moderation that exercised by some Web forums or mass control that polishes the Wikipedia phenomenon (Dobson, T., Willinsky, J., 2007; Figallo, C., Rhine, N., 2002; Khe Foon Hew, Hara, N., 2006; Watson, K., 2007).

The invisible Web is an issue closely related with the quality one but while the quality problem is in sorting and proofing the found answers, the invisible Web is about actually finding the answers when they are needed (Dotsika, F., Patrick, K., 2006; Patrick, K., Dotsika, F., 2007). An increased capacity and improved algorithms of indexing of search engines is one solution while the other approach might be in leveraging socialisation channels rather than search algorithms. It may be interesting to see how the “word of mouth” approach applies and works on the Web and if it can compete with search engines with regard to the speed and correctness of the retrieved answers.

Knowledge gaps is another essential subject that is concerned with real and perceived differences between Knowledge resources and background of various sectors, especially in the geographic context (Elenurm, T., 2004; Evers, H-D., 2003; Khe Foon Hew, Hara, N., 2006; Stankosky, M., 2005). Since the Web is free and available to everybody regardless of their location and position, it appears as the most suitable means for closing such gaps but further studies may be relevant to confirm this.

The Web Knowledge was singled out as a separate form of Knowledge here but perhaps it would be more correct to call it e-Knowledge instead (Rao, M., 2004). After all, electronic Knowledge available offline is considerably bigger than the Web, or online Knowledge.



Legal issues might be worth an independent research (Alexander, B., 2006; Plant, R., 2004). Data privacy and intellectual property rights are the two major areas here because a tenacious pursuit of Knowledge on the free Web may translate into a violation of somebody's privacy as well as their intellectual property rights.

Since the world is multi-lingual and the Web to some extent too, a true Knowledge mechanism must be able to overcome language issues and work well in any language. Global Dictionary is one of the concepts suggested for this but this idea can also be developed into something else (De Judicibus, D., 2008).

Semantic Web is a buzzword nowadays and examining it further is certainly worthwhile (Dotsika, F., Patrick, K., 2006; Gupta, J., Sharma, S., 2004; Rao, M., 2004). While it is mainly devised for the explicit Knowledge, the variation called Giant Global Graph (GGG) appears to be combining both explicit and tacit components and its development may bring interesting results (Berners-Lee, T., 2007).

The Wisdom Web can be another avenue for research (Elenurm, T., 2004; Rowley, J., 2006). Since Wisdom is a natural continuation of Knowledge according to Knowledge pyramid, the Wisdom Web can also be on the horizon.

Some other issues including, among others, cost, metrics and benchmarking of Knowledge, may be also appropriate to address. The Web is free and Knowledge is also best cherished when shared freely but there are still many cases when there is a price to pay for obtaining Knowledge on the Web. What is the real cost of growing and harvesting Knowledge online can be an interesting subject. Measuring and benchmarking Knowledge in general and the Web Knowledge in particular is another challenging area with more questions than answers and sorting it out should yield a lot of benefits.

A word of caution in the end. Despite an almost natural desire to bring order to the unstructured and uncontrolled essence of the Web, it should actually be resisted rather than facilitated. Just like Knowledge itself, the Web is naturally fuzzy and this is

exactly what makes them so closely related and any attempt to systematise either may have the opposite effect. “It’s fairly chaotic, and that’s good” (Stenmark, D., 2003).

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