

# Functionalities and Flow Analyses of Knowledge Oriented Web Portals

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## Abstract

The concept of knowledge starts from the individual, from his critical analysis and on how one interacts with people and objects around. The goal of this paper is (i) to investigate the treatment of knowledge, (ii) highlight that Social Networks (SNs) and Best Practice Networks (BPNs) are the best Web technologies available on the market for its management, (iii) make a comparison among the most diffused Social Platforms with the Best Practice Networks, in terms of functionalities offered for the knowledge management, analyzing the knowledge flows in all their complexity and entirety, (iv) evaluate all the previous aspects, taking into account our BPN applied in a Social Portal. Our aim is to study a new model to make a comparison among the most diffused SNs and the BPNs, that we are developing. This model takes into account the functionalities available in the portal, and the treatment of the knowledge.

Topics: collaborative and social multimedia systems and solutions, management and fruition, intelligent multimedia computing, user profiling.

## 1. Introduction

In recent years, organizational aspects related to knowledge management and to intellectual capital management have been largely studied; many methods and models of interaction and communication among people have been developed, in order to study the organizational implications related to the creation, storage, movement and use of knowledge [1], [2], [3], [4], [5]. In many of them the knowledge is not seen as a static concept but as a continuous becoming: it is a set of ideas that are born, spread and grow up through the interactions among people. Moreover the activities of creation, acquisition, management, dissemination, use and application of knowledge involved in working flows, involving individuals, are heavily influenced by the dynamics of social and organizational type [6]. These models have been fundamentally applied on business contexts. However, the methodologies adopted are so general that can be easily extended and applied in a variety of contexts. One of the most relevant knowledge treatment models is the SECI, studied by Nonaka and Takeuchi. This model sees the knowledge as a collection of facts, information, skills that a person acquires in the course of his/her life. Basically, two types of knowledge are outlined: explicit and tacit. Explicit knowledge is a formal,

systematic language, that can be expressed and shared in the form of data, in scientific formulas, specifications, manuals and so on; it can be processed, transmitted and stored relatively easily; tacit knowledge is in the human mind and it is highly personal and hard to formalize, externalize or mediate, represented by using the normal channels of communication. The SECI model talks about how the tacit knowledge is converted in explicit and vice versa. The SECI model defines four modes of knowledge conversion: Socialization (from tacit to tacit knowledge); Externalisation (from tacit to explicit knowledge); Combination (from explicit to explicit knowledge); and Internalization (from explicit to tacit knowledge) [2] (see Fig.1).

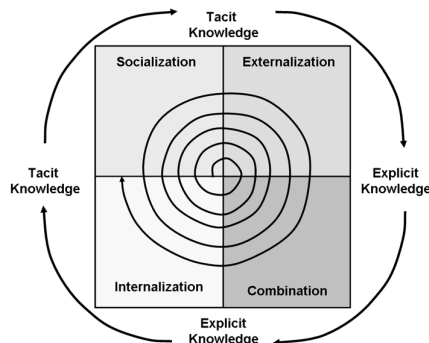


Figure 1: The SECI spiral model, inspired by [1].

In Fig. 1 it is also possible to see the Nonaka's spiral-like process: the knowledge is transformed through exchanges among individuals and groups, within the organization, across the four modes of knowledge conversion described above. This process does not stop once it has closed the circle, but continues into a new knowledge-creating spiral [3] [4]. This result increases the intellectual capital in its various components: organizational and relational. An appropriate organizational structure and the correct technology solutions, adopted in support of such a cycle, may enhance the effects of knowledge management in the growth of intellectual capital [6]. The most advanced organizations, structure their intellectual capital through the ICTs, often using Social Networks; from this point of view, many studies have been developed to match ICTs and SECI Model, such as [7] [8]. Some Social Networks are mainly focused on contents (e.g., YouTube, Flickr, LastFm) [9], whereas others are more focused on establishing relationships among users

(Facebook, MySpace, Orkut, Friendster, etc.) [10]. SN Analysis is typically focused on analyzing relationships among users and group of users, in order to identify which are the most central users and groups and, on the other hand, which are those that are frozen out, namely being those running the risk of losing interest in the network activities, due to a serious lack of involvement [11] [12]. On the other hand, Best Practice Networks are thematic SNs, where smaller groups of users share content, contacts and information with a common goal. In this paper we analyze the differences among the SNs and the BPNs, in terms of functionalities and knowledge flows; the goal is to study a methodology that can be used to classify and establish the most efficient instrument, in terms of stimuli given to the users, to enhance their creativity and to develop new knowledge. After this, we apply this methodology and verify its validity, through the analysis of data related to users' activities on our BPN, applied in a real context (i.e., the ECLAP portal). The paper is organized as follows: section 2 describes the SECI knowledge model applied on SNs and BPNs; in section 3 a comparison among SNs and BPNs in terms of functionalities is presented; in section 4, the functionalities are described as flows of knowledge; section 5 an analysis related to our Best Practice Network is presented.

## 2. SECI model, SNs and BPNs

Through the SECI conversion process, tacit and explicit knowledge expands in both quality and quantity, both in the Epistemological Dimension and also in the Ontological plan, that takes into account the human types of interactions (see Fig. 2).

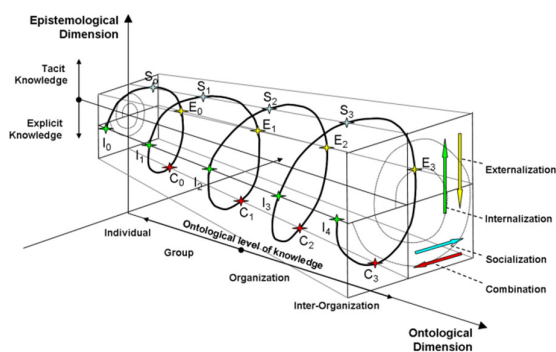


Figure 2: The SECI spiral model.

Given the wide spread of SNs and BPNs, the more relevant functionalities provided by these technologies will be analyzed and related to the SECI model. One of the aims is to determine which are the most capable platforms, to provide stimuli and incentives for the users, that are capable to assess the effectiveness of a platform, with respect to the others. Both the SNs and the BPNs provide for their users a set of functionalities, allowing them to make actions on the portal. Each user action has its flow of knowledge, basing on the SECI spiral model: it starts when people use the platform (Externalization), passes through the platform

elaboration (Combination) and ends creating new knowledge or giving stimuli to the users (Internalization), to elaborate new ideas also involving the network of users (see Fig. 3). Talking or meeting other people both in the virtual spaces provided by the Platform (e.g. friends, forum, blog, thematic groups, suggestions, etc.) but also in the real world (Socialization), facilitates the users in exchanging their ideas, thus allowing the growth of the knowledge level, and stimulate the users to start again to put new knowledge in the platform (Externalization mode).

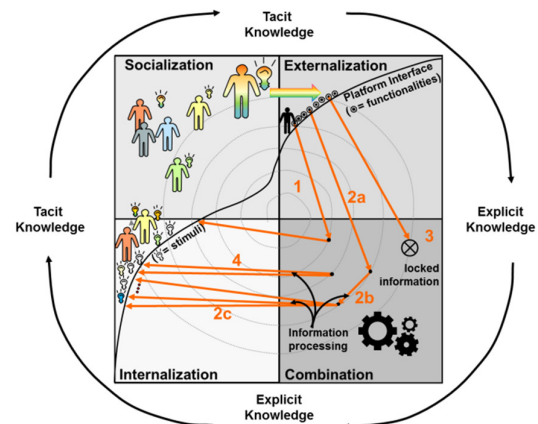


Figure 3: SECI - BPNs, SNs: actions flow.

The flows of knowledge, that are present in a Social Platform (SNs or BPNs), can be classified in four different types:

- *Direct flow* (User to Users): includes actions carried out by users and addressed to other users of the platform, with a little work (in terms of knowledge-reprocessing transformation) made by the platform itself (e.g. make a comment on a content, add a new friend, etc.);
- *Mediate flow* (User to Platform and Platform to Users): includes actions brokered by the platform, actions in which the users put their knowledge on the portal (uploading content, filling their user profile, ranking, etc.). The portal processes the information and produces stimuli for them or for other users; in this case the Portal itself generates new knowledge. This type of flow is composed of three main steps: *i*) actions done by the users on the Platform; *ii*) analysis and elaboration of data made by the platform; *iii*) production of stimuli for the end users (e.g. recommendations, suggestions, etc.).
- *Locked flow* (User to Platform): it occurs when users put their knowledge in the platform or make actions on it, and the platform does not register the information given, with a consequent loss of information;
- *Platform flow* (Platform to Users): it includes all the functionalities automatically provided by the platform that do not depend on the user's actions or on the knowledge that they have put in the platform (e.g. basic functionalities such as: give

the possibility to upload content, to make queries on content, to search new friends, etc.).

All the flows that begin on Externalization are made by the users: they produce new knowledge because they put their ideas, interests and creativity on the Portal. All the flows that begin in Combination, involve the Platform processing capabilities that can be minimal (for example when the user writes a web page, or makes a query on the portal), or can be very complex and capable to create new information, useful to stimulate the users (this is the recommendation sample). Moreover the more are the functionalities offered to the users (in Fig. 3, they are represented by the arrows ending on Internalization), and the more are the stimuli given to them. Following the SECI spiral model, users can do actions on the portal (Externalization) and, if they receive interesting stimuli from the Platform (Combination and Internalization), they can chat, share information or competencies, talk together (passing from the Socialization mode of knowledge conversion) and put new knowledge on the Portal (again starting their actions on Externalization, this time with a more high level of knowledge, see Fig. 3).

### 3. Comparison among the BPNs and the Social Networks on Functionalities

Both the SNs and the BPNs provide for the users a set of functionalities, allowing them to make actions on the portal. In order to analyze what type of platform can be considered the most effective and efficient to stimulate the creativity of the users, enhancing them to develop new flows of knowledge, we have realized a comparison in terms of functionalities. We have chosen YouTube (SN oriented to content), Facebook (SN oriented to users) and our Best Practice Network. We have selected the following functionalities as the most effective to give stimuli to the users:

- Content Download and View
- User Friendship
- Portal Registration
- Suggestions
- Searching
- Content Ranking

It is possible to see the result of this comparison in Fig. 4. The functionalities can be offered both to Public Users (PU) and to Registered Users (RU), and can have a different level of importance (high, low or medium), depending on the Platform mission or structure.

Functionalities for Public Users (PU) & Registered Users (RU)		YouTube	Facebook	Our Best Practice Network
Content download & view	Audio	-	-	high (PU&RU)
	Video	high (PU)	low (RU)	high (PU&RU)
	Images	-	High (RU)	high (PU&RU)
	Documents	-	Medium (RU)	high (PU&RU)
	Cross Media	-	-	high (PU&RU)
Portal Registration	low (PU)	high (PU)	high (PU)	
User Friendship	low (RU)	high (RU)	high/medium (RU)	
Suggestions to users	Same for all	high (PU&RU)	low (RU)	high (PU&RU)
	Different for each user	medium (RU)	medium/high (RU)	high (RU)
Searching	Content	high (PU&RU)	-	high (PU&RU)
	User	-	high (RU)	high (RU)
Content Ranking		high (PU&RU)	medium (RU)	medium (RU)

Figure 4: Functionalities on YouTube, Facebook and Our BPN.

It is possible to observe that:

- YouTube is focused on contents; user registration to the portal is not so relevant: the main services are provided for the Public Users and are obviously related to the contents;
- Facebook practically provides functionalities only for registered users, and it is mainly centred on making new friends and relationships among users, even if it keeps attention also on contents;
- BPN is equilibrated in terms of functionalities and on the type of users for which they are provided.

### 4. Analyzing functionalities and flow of knowledge

In this section it is detailed how the Portal's functionalities can be matched with different types of flows of knowledge. Each flow is composed of actions made by the users or by the platform itself; each action (see Fig. 5) starts and ends in one of the four SECI model modes of knowledge conversion, and corresponds to one of the flows (or even only to a part of them, in the case of type 2 flow), identified in the preceding paragraph. Each mode of conversion involves a knowledge transformation:

- Externalization: from tacit to explicit (T→E)
- Combination: from explicit to explicit (E→E)
- Internalization: from explicit to tacit (E→T)
- Socialization: from tacit to tacit (T→T)

Actions that transform the knowledge from tacit to tacit are almost never supported by virtual media. These actions usually take place in the real world, and are not supported in their entirety by SNs or BPNs platforms (conversations, meetings, reunions, etc.). In Fig. 5 is presented the model to compare the functionalities and the types of knowledge flows in a SN or in a BPN (detailed in section 2).

Functionalities and flows of knowledge					
	Start		flow type	End	
	Kind of user	Action		Result of the action	Kind of user
Functionality	Individual, Platform	T→E E→E (E→T)	1,2, (3) or 4	E→E E→T (T→E)	Platform, All users

Fig. 5: Functionalities and flows of knowledge model.

It is useful to make some examples and take into account the legend here after.

Action: Write a public Web page. Knowledge flow type: *Direct flow*.

- Start: the user starts from its own knowledge (tacit), uses editing tools and creates a web page on the platform (explicit). So the passage of knowledge is from tacit to explicit: T→E;
- Result: this is the result of the user action. The user has produced a Web page, visible to all the users of the platform (explicit); the users can read it and get information (tacit): E→T.

Action: Recommendations. Knowledge flow type: *Mediate flow*.

- Start: the platform produces and offers to the user a list of recommendations (explicit) and the user sees them. In this case the knowledge flow is from explicit to explicit: E→E;
- Result: the user reads the recommendations (explicit), acquires and reworks the information provided by the platform (tacit): E→T.

Platform functionalities and flow types					
	Start		flow type	End	
	Kind of user	Action		Result of the action	Kind of user
Content view	Platform	E→E	4	E→T	All users
Content download	Individual	T→E	1	E→T	All users
Portal Registration	Individual	T→E	2a	E→E	All users
User Friendship	Individual	T→E	2	E→T	Individual (friend)
Suggestions to users	Platform	E→E	4	E→T	All users
Searching	Individual	T→E	2	E→T	Individual
Content Ranking	Individual	T→E	1	E→T	All

Figure 6: BPN, sample on user functionalities.

In Fig. 6 are described the top functionalities, previously used to compare the SNs and the BPNs and their relations among the different knowledge flow types analysed in section 2. It is possible to note that:

- YouTube is focused on functionalities starting on the Combination mode of knowledge conversion;
- Facebook provides functionalities that involve flows mainly starting on Externalization (new knowledge from the users);

- The BPN is equilibrated: the functionalities involve all the knowledge mode of conversion.

## 5. BPN functionalities analysis

The analyzed BPN has been developed on the basis of an infrastructure called XLMS (Cross Media Learning Management System). Other BPNs has been deployed in various contexts by using XLMS infrastructure. The most relevant BPN from the point of view of the knowledge management analysis is ECLAP. ECLAP Portal is a BPN and content aggregator for the ECLAP European Project, [13]. The collected data are related to both content present in the platform and user behaviors. ECLAP Portal resources are divided in Cross Media and Drupal contents ([14]), accessible through Searching or Menus of the portal. Cross Media types include: archive, audio, braille music, collection, crossmedia, document, event, epub, excel, flash, html, image, pdf, playlist, slide, smil, tool and video. Drupal Content types include: blogs, forums, groups and pages. Cross Media contents may be annotated, recommended to other users, added to a playlist or to a personal collection, edited, downloaded, marked as favorite or featured, commented, tagged and voted. Drupal contents may be commented and voted. Also, each Cross Media or Drupal content may be linked and suggested to users in other Social Networks, with 1-click icons (i.e., del.icio.us, digg.com, Facebook, Twitter, MySpace, Messenger, Orkut, Plaxo, LinkedIn, Google). The following analysis has been conducted in the period September 1<sup>st</sup> – November 30<sup>th</sup> 2011. The ECLAP community consisted in 606 registered users, with 23544 digital items.

### 5.1 Cross Media Playback and Download

When playing multimedia contents (videos, audios, documents, images, and cross media), a right panel shows related metadata in various languages, content taxonomical classification, IPR information, and geolocation data. Cross media content access is one of the most exploited functionalities on the ECLAP portal. Cross media contents collected 7084 views and 1080 downloads. Top accessed contents include pages, pdfs, images and videos. These kinds of content can be accessed through searching, popular content lists or email notifications. A small fraction of the users accessing Cross Media content decided to download it. Images and videos are viewed by users, but generally not downloaded. Downloaded Cross Media contents include resources that are not usually intended for leisure or entertainment, so that the typical downloader is a technical/professional user. Playlists and Collections were the less exploited contents on the portal, with few creations and accesses from users.

### 5.2 Drupal Resources View

The main Drupal contents include pages and groups. Registered users can create, edit and translate these contents, with an online rich text editor (plain or html).

The ECLAP portal features two types of blogs: general and groups related. The general blog is the main project repository page, containing updated news about the project related tasks and activities. This single page collected nearly 100 clicks per day from the ECLAP menu. Groups related blog accesses are about 6.2% of all blog accesses. Pages are accessible through searching, groups, newsletters, or content lists; despite the relatively limited number of page items on the portal, this kind of content was fully exploited by users, with more than 100 accesses per day in the considered period. The most 3 accessed pages, collected about 26.4% of total page accesses (respectively 9.6%, 8.5% and 8.4%). After groups, pages were the top accessed Drupal resources (44.17% of Drupal content accesses, 33.09% of total views on the portal). The general ECLAP page collected 673 accesses (7.47 per day, about 1 access each 12 visits to the portal). During the sample period, the 28 groups created since the start of the project collected 9789 views, more than 100 per day. This was a very popular resource highly exploited by users, and the top most exploited resource, collecting about 46.27% of all Drupal views (34.66% of total views). Drupal resource had 74.91% of total views performed on the portal.

### 5.3 User Friendship

Each registered user can receive connections and friendship requests from other users in the ECLAP BPN; each request is notified in a right box, and can be accepted, ignored or denied. A list of potential colleagues is provided for the logged user. Users have a personal page that includes: specialization and job, general information, proximity details, list of colleagues, messages and subscriptions. Registered users have inbox and sent folders, and can send and receive private messages. Friendships and connections between users were established mostly by partners (92.26%); messages were exchanged mostly by partners too (66.67%). These numbers suggest that the registered social activities were about technical tasks between the project partners.

### 5.3 Portal Registration

Anonymous users can register on the ECLAP BPN with the Register button in the top right of the portal. After entering a captcha secure code and registering, the user receives an email with a confirmation link, for profile activation. In the considered period, there were 396 user registrations, with an average of one registration each 20 visits on the portal.

### 5.4 Suggestions

Content suggestions are available at access level or menu level. Similar contents were accessed 2864 times. This means that on average 9% of users who accessed contents, decided to play a content proposed to be similar to the accessed one. Similar content views per visit was 0.35. Featured content was the most exploited content list, with 343 clicks (about 30% of total content

list accesses), followed by Last Posted (23%) and Popular contents (20%). Content lists collected 1140 clicks from users, about 0.14 clicks per visit and 12.67 clicks per day.

### 5.5 Searching

Search is divided in simple and advanced. Simple search allows full text search of ECLAP resources, eventually filtered by type. Query services were one of the top exploited functionalities in the portal. Most of the queries were of simple type (about 99%), performed from the main page, and a limited fraction were advanced queries. 65% of queries were performed from public users. Users performed about 0.50 simple queries per visit on the portal. As for advanced queries, faceted queries were not significant in number; 76.56% of faceted search were performed by public users. Queries through keyword or query clouds were about 4.9% of total simple queries. 46.34% of advanced queries were performed by public users. 1764 items was viewed after performing a query, thus 39.33% of all queries performed resulted in a click by the user on some result. 411 viewed contents after performing a query were of type Drupal (23.2%), and 1353 cross media (76.70%). This is in line with the data accounting for 74.91% of Drupal content views and 25.08% cross media views, so that user preferred more Drupal related contents to cross media, despite the limited amount of Drupal items, compared to Cross Media contents. Top search result clicks were on groups (12.14%).

### 5.6 Content Ranking

ECLAP contents can be ranked by registered users, using a 5-star based scale. Top ranked items are collected into a separate list, on the right menu of the portal. Contents report their average score. Votes assigned to contents can be changed at any time.

Functionality	Target	Source Path	Total users' Accesses		
Oriented to manage content	Crossmedia View/Play	RU&PU	Search Filter (2) Content lists (2) Keyword Cloud (2) Query Cloud (2) Groups (2)	7084 (pdf: 2543, image: 2477, video: 1614, ...)	Total users' actions on content 12656
	Searching (Simple, Advanced, Faceted, Cloud search)	PU&RU	Search Form (0) Menu (1)	4484	
	Crossmedia Download	RU&PU	Search Filter (2) Content lists (2) Keyword Cloud (2) Query Cloud (2) Groups (2)	1080 (pdf: 884, document: 70, slide: 39, ...)	
	Crossmedia Ranking/ Voting	PU&RU	Featured (2) Search Filter (3) Content (3) Keyword Cloud (3) Query Cloud (3) Groups (3)	8	
Oriented to manage users and social interactions	Drupal contents View (blogs, pages, groups, forums)	RU&PU	Groups (3) Menu (1) Search (2)	20111	Total users' social actions 20522
	Portal Registration	PU	Register Button (1)	396	
	User Friendship (direct messages, invitations)	RU	Menu (3)	15 (messages: 9, invitations: 6)	

Figure 7: BPN, sample on user functionalities.

### 5.7 User Behavior

Public users typically started their session by clicking on the ECLAP menu in the top home page (24.73%), viewing a content (cross media 21.83%, drupal 15.83%, group 14.77%), or performing a query (12.79%). Most

popular second and third clicks nearly exhibited the same behavior. Users finished their sessions by viewing a page, clicking on a menu or accessing a group page. Registered users started their sessions logging in the portal (50.83%), then clicking on the ECLAP menu, and viewing an event page or a generic page (8.97%). Most popular second clicks include menu access (28.32%), viewing event pages (14.33%), and pages (11.6%). Third clicks generally were menu access (31%), viewing event pages (20.93%), and viewing groups pages (11.24%). Top sessions last clicks were on event pages (23.25%), cross media content access (54%) and menus (17.6%). In Fig. 7, we classify the main functionalities, just described as oriented to manage content or to enhance social interactions. Taking into account the table it is possible to note that:

- functionalities are mainly addressed both to Public Users and to Registered Users;
- user actions (evaluated through their access on the portal) are equally: *i*) finalized to manage content (total access: 12.656) and to establish social connections on the portal (access: 20.522) *ii*) distributed in terms of SECI modes of knowledge conversions (with the exception of the Socialization, that is mainly based on relations among people in the real world, and not through the use of web platforms);
- social connections are mainly oriented to contact the ECLAP Partners, because of the Portal mission. In general, the functionalities provided are oriented to enable the Partners to do their work on the BPN, and not created to enhance leisure or for entertainment (aspects that could be more interesting for new users).

## 6. Conclusions and Future work

In this paper we have described a new modality to analyze the capabilities of the SNs and the BPNs, starting from the SECI model, analyzing the functionalities offered by the Social Platforms in terms of flows of knowledge. We have collected and evaluated data related to our Best Practice Network applied in a real context (i.e., the ECLAP portal). Future work includes: *i*) increase the user behavior analysis, especially taking into account the sequence of the actions made by the users during a session. This, in order to establish if a functionality provided by the platform has really stimulated the users (to produce new knowledge, to make new friends, to chat with colleagues, etc.); *ii*) establish metrics to evaluate what are the points of strength or weakness of the platform, to give new stimuli to the users: how to increase the data processing capabilities (Mediate and Platform flows) and decrease the loss of information (Locked flow); *iii*) make a comparison among our portal, eventually applied in other contexts, and the most diffused Social Portals at data level and not only basing on functionalities (through the data crawling, etc.).

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