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Abstract

Social network sites (SNSs) are increasingly attracting the attention of academic and industry researchers intrigued by their affordance and reach. Most website, like Facebook, Twitter, LinkedIn and so on, connect people that don't know each other based on shared interests, political views, photos, videos and in general important part of life. Some sites cater to diverse audiences, while others attract people based on common language or shared racial, sexual, religious, or nationality-based identities. Social networking websites could be harnessed for immense benefit to the scientific sector. A scientific social network allows scientists to share ideas, details of their current research and freely distribute their results. It would reduce wasteful scientific redundancy, for instance, by preventing scientists from doing experiments others have done before them, and it would also enable cooperation between groups across the world.
In this Technical Report we present our SNS platform called CNR@wOrK and discuss about its developments and future improvements.

Contents

1. Introduction

According to definition of Boyd-Ellison (1), ***social network sites*** (SNSs) are web-based services that allow people to:

- construct a public or semi-public profile within an integrated system
- articulate a list of other users with whom they share a connection
- view and traverse their list of connections and those made by others within the system.

The nature and nomenclature of these connections may vary from site to site. For example on Facebook the connection is called "friendship", on LinkedIn is a generic connection for work or school, differently on Twitter you can choose to follow the post of certain a user.

Through these websites one can extend and enforce his own personal contact network, to meet people, to share interests and other information.

For the users, social network sites (SNS) are a big opportunity for creating a storefront for friendship or job (LinkedIn) or to "share with the people in your life" (as stated in Facebook's title).

In the last few years, the importance of the SNS has grown greatly so that many applications has been developed, that cover related areas. The number of applications developed in the U.S. has been growing by 250% in the last five years.

Recently, the magazine Wired Italy has compiled the rankings of the 10 most powerful Chief Executive Officer (CEO) of the Web and in the first three positions there are CEO of SNSs: in order, Mark Zuckerberg (Facebook), followed by Dick Costolo (Twitter) and by the Italian Gianluca Cozzolino (CiaoWeb) (2)

1.1. Brief History of SNSs

The first social network site, in the history of Web, was SixDegrees.com (1997). This social network was aimed to allow people to connect each other and to send messages. The experiment failed because wasn't a sustainable business and the service closed after 3 years.

From 1997 to 2001, a number of community tools began to support various combinations of profiles and connections between users. Among them, AsianAvenue, BlackPlanet, MiGente, LiveJournal, CyWorld added SNS features in 2001. Likewise, the Swedish web community LunarStorm refashioned itself as a SNS in 2000.

The next wave of SNSs began with Ryze.com, in 2001, launched to help people leverage their business networks: it never reached mass popularity.

In 2003, MySpace was launched in Santa Monica (California) to compete with sites like Friendster, Xanga and AsianAvenue. In a few time, it became the most popular SNSs. One of the reasons that contributed to expand MySpace is that the SNS was able to grow rapidly by capitalizing on Friendster's alienation of its early adopters, worried that Friendster would adopt a fee-based system. The symbiotic relationship between bands and fans helped MySpace growing. The bands and fans dynamic was mutually beneficial: bands wanted to be able to contact fans, while fans desired attention from their favorite bands and used friends connections to signal identity and affiliation.

In February 2004, Facebook was created; it grown quickly and in 2010 it became the most popular SNSs. An interesting feature of Facebook, - that represents an innovation respect to the other SNSs - is the ability, for outside developers, to build their own applications.

While most SNSs focus on growing broadly and exponentially, others explicitly seek narrower audiences: for instance, aSmallWorld and BeautifulPeople intentionally restrict access to appear selective. Others, activity centered sites (like Couchsurfing), identity driven sites (like BlackPlanet) and affiliation focused sites (like MyChurch) are limited by their target demographic and thus tend to be smaller.

Finally, anyone who wishes to create a social network site can do it on Ning, a platform and an hosting service that encourages users to create their own SNSs.

Figure 1 show most popular SNSs in terms of number of users based on data presented in (3), (4):
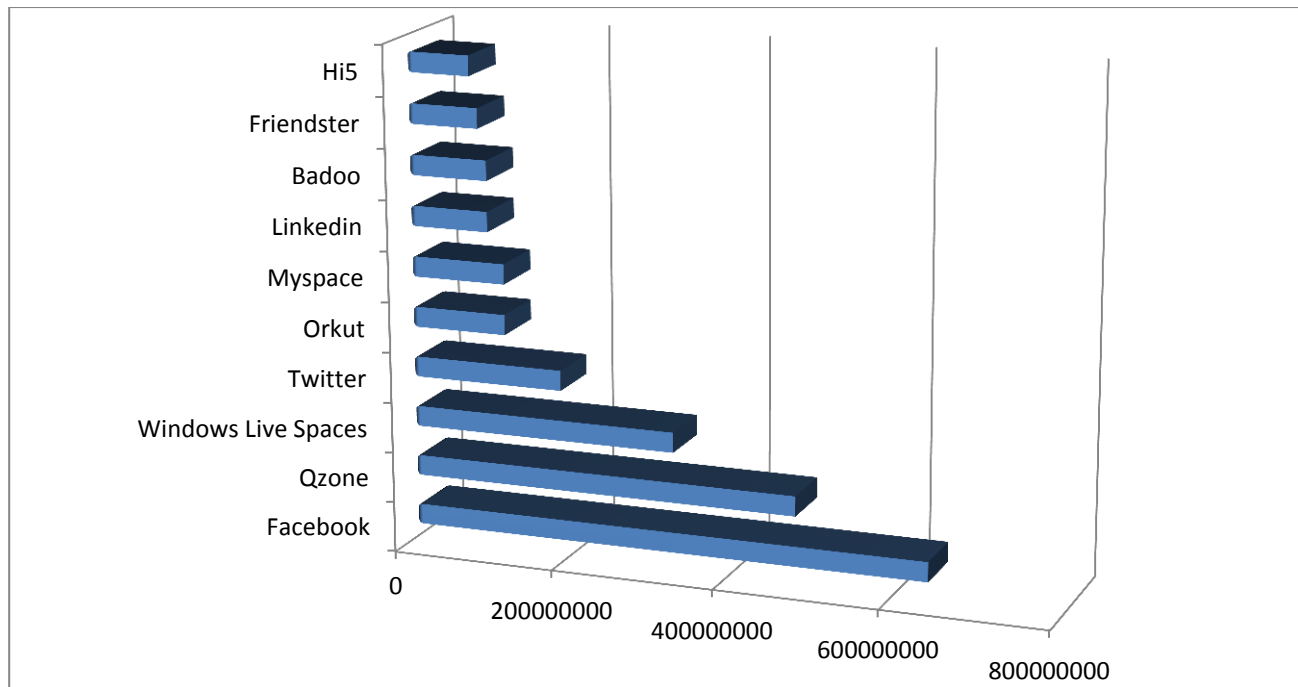
Figure 1 - Most popular Social Network Sites in terms of number of users

The rise of SNSs indicates a shift in the organization of online communities. While websites dedicated to communities of interest still exist and prosper, SNSs are primarily organized around people, not interests, with the individual at the center of their own community. This more accurately comes from unmediated social structures, where "the world is composed of networks, not groups" (5).

2. State of the art

Nowadays there are many SNSs: the major part is generic, while others are focused on a purpose. To classify the existing SNSs we can exploit the categorization presented in (6); SNSs are divided in:

- generic
- scientific
- business oriented
- educational

2.1. Generic SNS

Generic SNSs allow users to "keep in contact" with friends; the most popular are:

- **Facebook:** a social network launched in 2004 by Mark Zuckerberg. On this SNS, users can create a profile with personal information, photos, video, contact information, list of interests, etc. Furthermore users can communicate with friends trough private or public (posts) messages or exploiting a chat feature, can create and join groups and can express their personal opinion with the mechanism "I like it". Today the number of people that use this social network is more than 500 million (active users) (7).
- **Twitter:** a social network based on micro blogging. It allows users to send text-based post composed by 140 characters (called *tweets*) or to follow different users' tweets on their own wall. Starting from April 2010, Twitter allows also companies to purchase "promoted tweets".
- **Diaspora:** a private, open source social network that leaves to the users the full control of his personal data and, consequently, protect their privacy. Diaspora is a distributed network where computers are connected to each other directly, without any central server.
- **Foursquare:** a social network location based, used primarily for mobile devices. The user "check-in" in a place using a mobile website, a text message or an application for smartphone (like iPhone, Blackberry, Nokia, or Android-based smartphones, etc.). The service was created by Dennis Crowley and Naveen Selvadurai in 2009. In April 2011, the registered users were more than 8 million (8).

2.2. Scientific SNSs

A scientific SNS connects people that work in different field of science; we can mention:

- **Mendeley:** a free, proprietary desktop and web software for managing and sharing research papers, discovering research data and online collaborations.
- **ResearchGate:** a free social networking site and a collaboration tool designed for scientific researchers from all disciplines of science. It provides web applications including semantic searching (whole abstract searching), sharing of file and publication's database forums, methodology discussions, groups.
- **ScienceStage:** a global, science-oriented, multimedia portal. The main feature is the online video streaming, which is used to support communication between scientists, scholars, researchers in industry, and expert in different fields. ScienceStage also acts as a 'hub' by creat-

ing a meta-layer that enables the networking of both users (people and groups) and content (video, audio, and documents)and represent an integrated multimedia and social networking platform for scientists.

- **Pingsta:** an intellectual collaboration platform exclusively for Internet engineers; membership is by invitation or application.
- **DIGRII:** a social network that allow discovering the separation's degree between you and the rest of world. This social network is based on the theory of "six degree of separation" (7) that assumed that every people is separated, on average, by six step from any other person on a generic social network. Unfortunately this social network has less than 2000 registered users.
- **BiomedExperts**: a social network that connects biomedical researchers. This SNS visualizes and analyzes the network of co-authors of published scientific papers. The system is pre-populated with expert's profiles and allows scientists and researchers across organizations to share data and to collaborate.

2.3.   Business Oriented SNSs

The business oriented SNSs aim to create professional network for looking jobs or scouting people; the most significant are:
- **LinkedIn**: a business-oriented social networking site. It use a "gated access approach" (where contact with any professional requires either a preexisting relationship, or the intervention of a contact of theirs) that intends to build trust among the service's users.
- **Viadeo**: is a Web 2.0 professional social network. It groups features of many SNS: users can join a community or create its own, can looks for a job, or consults events about his own interests, can publish advertisements about jobs, services, real estate and so on.

2.4.   Educational SNSs

Concerning educational SNSs the main ones are:
- **Academia. Edu: it** displays academics around the world in a tree format, according to the information of the university and departments they are affiliated with. It enables an academic to have an easy-to-maintain academic web page.
- **UniPhy:** it is the world's first literature-based professional social networking site for physical scientists. To use UniPhy the user not only has to register, but he needs to have published at least three papers that have been indexed in AIP's SPIN (Searchable Physics Information Notices) database.

2.5.   The success of a SNS

The success of a SNS is based on a principle of sociology: who is similar tend to be together (principle of homophily (8)). This could be a problem because information remains in the same working groups.
To increase the collaboration between different groups, the theory of weak ties, discovered by Mark Granovetter (9), can be useful. A weak tie is a user that is part of two groups with different characteristics: this user acts as bridges between these different communities.

For this reason, the management should be able to link different groups and encourage their interaction in a common environment.

The technology clearly enhances the power of weak ties and allows the collaboration and interaction of hundreds of people; this moves away from the traditional limitation imposed by the number of Dunbar (10).

According to that, we can deduce that it is very important that the information must be accessible to groups outside their regular scenario; an organizational climate and policies that encourage people to share and make available information by others are required.

Social networks provide a lot of tools that allow people to share interests, experiences and information. It's very easy to create groups for discussing specific topics, or adding notes, photos and video; it is also possible to create, in a few minutes, fan club or to play a video game with other people. In this way, users can also promote their own image before hiring a new person.

3. CNR@wOrK's goal

CNR@wOrK has, as the main goal, the achievement of a net of researcher and technologist to disclose and spread the research results from CNR and to promote the Technological Transfer (TT).
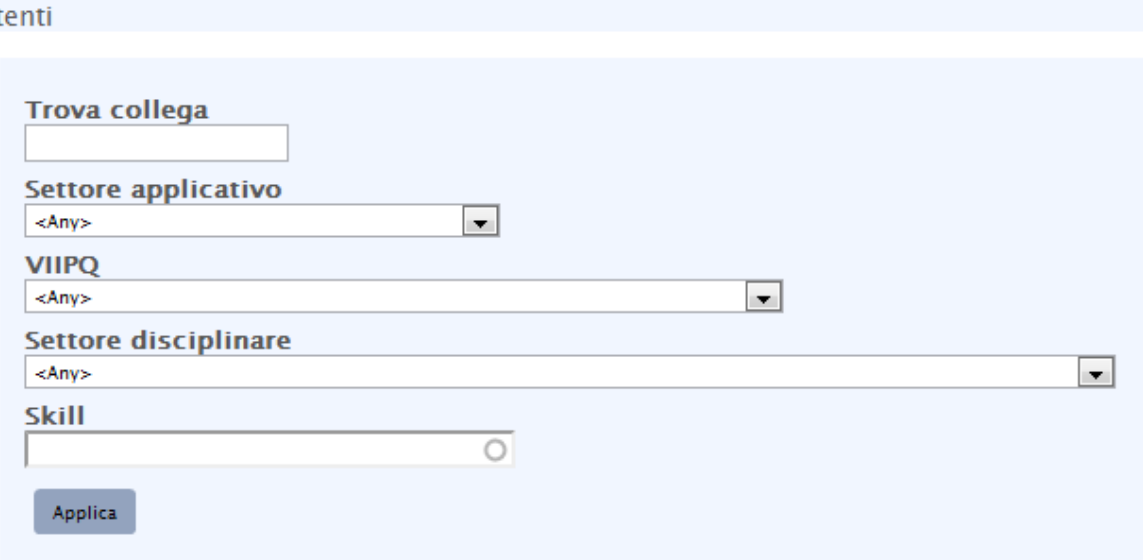
The social network platform is addressed to CNR people with the following objectives:

- to connect many people of CNR like researchers, technologists, technicians and administrative
- to improve the interdisciplinary research projects of CNR
- to activate and connect the skills of researchers in the network
- to improve the links between CNR and other realities

With CNR@wOrK, people will:

- advertise their researches, their skills, their personal interests
- share best practices (e.g. create a spin-off, participate in a European project, patent an idea, etc.)
- report territorial opportunities: regional and local initiatives, programs for innovation, contacts with industry
- give useful information on patents, protection of the results and vocational courses
- create discussions groups on topics of interest

CNR@wOrK can be used to search users with certain characteristics: this opportunity is very important for scouting (Figure 2).

Figure 2 - Example of research by skills in CNR@wOrK

3.1. Specific features of CNR@wOrK

The portal CNR@wOrK is accessible only via login: people need to be registered and have to create a profile. The registration is open to all the people working at CNR, but their request is subject to moderation.
In CNR@wOrK every user has a profile that contains his personal and professional data.
With "personal" data we indicate:

- name
- institution
- address
- e-mail
- telephone
- mobile
- Skype account
- personal image

Professional data are:

- department
- scientific sector
- topic Seventh Framework Programme and research challenges
- application areas
- keywords from the National Institute of Standards and Technology (NIST) list
- main collaborations (national and international)
- experience in technology transfer, dissemination, communication
- personal home page
- skills

In CNR@wOrK, users are identified according with following type of users:

- **authenticated user**
- **editor**
- **supervisor**

The **authenticated user** is the basic role and allows enjoying, without restriction, any social feature of the platform. Users with **editor** role are in charge to the content management of news, communications and events. Users with **supervisor** role can examine registrations' requests and create news, communications and events.
The portal consists of the following sections:

- **Profile** : the user's personal profile and the list of message from friends
- **Wall**: it contains the list of all the messages exchanged with their colleagues
- **Relations**: managing links between users
- **Posts**: mailbox that allows users to exchange private messages each other
- **Groups**: the list of groups joined by the user
- **Search interface:** a tool that allows to search people in the system according to the criteria of taxonomic research and external collaborations
- **GeoMaps**: CNR maps of locations and partnerships

- **News**: list of news and events concerning CNR. There is also a map displaying the location of the events

An example of profile is shown in Figure 3.

Figure 3 – Sections in user profile

CNR@wOrK is a Web 2.0 tool: it provides **microblogging**, **relationships** between users (friendship, private messaging) and **discussion groups.** The micro blogging phenomenon can be seen as a new channel for dissemination and communication; this is useful especially for collaborative work because, in this way, the communication became immediate and without constraints.

Compared to other SNSs, CNR@wOrK offers a section for news, events and announcements regarding CNR and the possibility to visualize in map all CNR locations, events and collaborations.

CNR@wOrK has also a mechanism of notice that will trigger when you receive:

- a comment on your post
- a private message from a group you belong

On CNR@wOrK any user can become colleague of another one by sending a request (like friendship request on Facebook); a email is delivered to the target user that can accept or refuse the friendship. A relationship can be erased in the same way as it is done.
A user can create or join different groups. A group is a homogeneous set of threads on the same subject. Groups can be of three types:

- **open:** no restrictions about subscription are required
- **moderate:** a user can request to join, but the proposal must be accepted by the administrator/creator of the group
- **closed:** only the administrator can invite and add users

In all three types of group, contents are visible only to registered members.
Group members can post messages and comments with the usual mechanism of the wall.There is also a feature of broadcasting, to send, by mail, simultaneously communications to all the group's members.

4. System Architecture

CNR@wOrK was implemented using the content management framework Drupal.
One of the major advantages of Drupal is its high modularity: it defines hooks, callbacks and API, through which it's possible to create modules to extend it, leaving unchanged the core. This is the key of the high flexibility of Drupal and the reason of its success, but this can also be a problem: in fact some modules are written by the community and sometimes they could be not reliable. Despite this, some modules are so stable that they can be used in complex projects, too.
At the base of the whole CNR@wOrK system there is the Drupal core; on the higher layer there are modules from the Drupal community and the ad-hoc modules developed for the purpose. Figure 4 shows the platform's architecture:
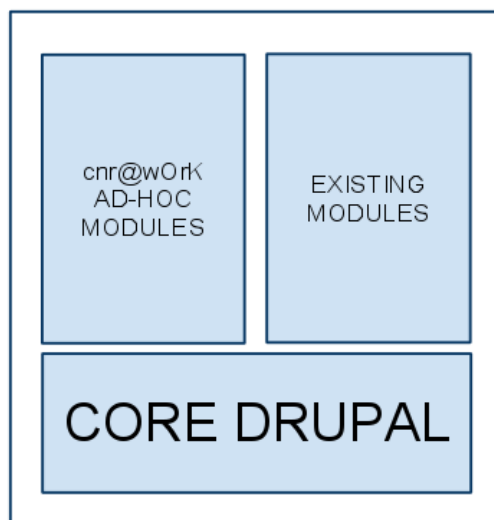

Figure 4 - CNR@wOrK architecture

In the following subsections we will describe the used/created modules concerning the offered features, that can be divided in the following classes:

- user profile
- relationships among users
- microblogging
- groups
- notifications
- news/events/official reports section
- private messages
- geolocalization of CNR's sites

4.1.   User Profile

One of the goals of a profile is to create a homogeneous and complete description of themselves.For user profiles the Drupal community exports many modules such as Content Profile, CCK (11), Taxonomy (12) , Embedded edit (13), Avatar crop (14).

For our purpose a custom module called "*Microblog profile*" has been developed. The "*Microblog profile*" module allows users to have a profile with job information and scientific areas on the social network and to use the institutional email as system username (as project specification).

The wall page, the personal board (in user profile page), and the group post page have been made with *View* module; the header of each view contains PHP code to present micro blog insert form.

An example of profile is showed in Figure 5:

Figure 5 - Example of user profile in CNR@wOrK

4.2. Relationships among users

The module called "User Relationships" (15) is used to create relationships among users: this module allows users to create named relationships between each other.This is the basic building block for a social networking site.
Admins can create different relationship types that can be one-way or mutual. If a relationship is one-way (subscriber) only those who require friendship is reported as related to the requested.

4.3. Microblogging

CNR@wOrK is designed to be an SNS and for this reason the micro blogging feature is very important: users have to be able to post brief text messages on personal wall, on other users' boards or on group spaces. For this reason, a Drupal module, called "Microblog", has been developed. Other modules involved are: *CCK* (11), *Views* (16), *Views Or* (17), *Ajax Views Refresh* (18). Every page is a distinct view with different filters and topics. The *Ajax Views Refresh* module allows the refresh of the views on Ajax forms submission.

To display the necessary fields of the micro blog form we have modified `template.php` file in the current theme directory. A new node in `microblog.tpl.php` file has been created to provide a graphic template the micro blog post.

The core comment system is inefficient to provide an Ajax way to insert comment inside a post view; other contributed modules don't offer this functionality because they work only when one node for page is displayed. In order to overcome this limitation a new module has been created, the *Microblog Comment* module. This module overrides the standard input form of a comment adding the jquery method "ajaxForm": the method save comment via Ajax and a callback function shows the comment just sent without page refresh.

In the module there are also two `tpl.php` files (`comment.tpl.php` and comment-`wrapper.tpl.php`)to manage the aspect, respectively, of the single comment and of the comments container.

4.4. Groups

CNR@wOrK allows users to create a protected area for private discussions exploiting the mechanism of groups.

Every single group has a home page where subscribers communicate among themselves. Each group can have different subscribers and maintainers.
For this functionality the *Organic Group* (19)and *Rules* (20) modules have been used.

The *Organic Group* module allows the creation of the following type of group:

- **Open**: everyone can access to the group
- **Moderated**: requests must be approved
- **Closed**: membership is managed by an administrator

Two new content types have been created:

- **Group** as group container
- **Group post** as microblog

In the group home page are displayed the participants' pictures, commands to join/request participation to the group, and the link to the administration interface (only for group admins).

4.5. Notification

On CNR@wOrK a very important role is played by notifications that allow users to have a real-time feedback about other users actions on the SNS (new posts on personal board, posts in group, comments).
A custom module, called "*Microblog Notification*", has been created to manage this functionality.
This module uses the Ajax technique to retrieve information about user notification.
A routine checks if there are notifications for the current user at regular intervals; if there are some new actions, the module shows the number of unread items and a link to the complete list.

4.6. News, Event, Official report

A special area with news, event and official report has been created to improve the intercommunication across the CNR.
For this functionality Drupal community modules such as *CCK* (11) *Views* (16), *Rules* (20), *Date* (21), *Calendar* (22), *Gmap* (23) have been used.
New contents "News", "Event" and "Communication" (official report) have been created with *CCK* module. The "Event" content type uses *Data* and *Gmap* modules to associate the date and a geographical location at the event.
A specific role "editor" has been introduced to create new contents. When a user with 'editor' role inserts content in this section, a specific rule (created with Rule module) sends the body of the content to all users via email.
All the lists have been created with *Views* module; moreover with the *Calendar* module a plugin with a calendar style view has been made for events content.

4.7. Private messages

CNR@wOrK users can communicate using private messages, too. This feature was implemented by the *Privatemsg* module (24).
Main features of this module are:
- sending and receiving private messages (between multiple recipients)
- threading conversations (make it easier to keep track of messages and replies)
- tagging and filtering (helps to organize conversations)
- user blocking
- email notifications of new messages

4.8.   CNR's sites map

Researchers and technologists participating in CNR@wOrK are affiliated with different departments of CNR, located across Italy; so, a new features was added in CNR@wOrK to display on a map all the CNR's offices.For this purpose *CCK* (11), *Views* (16) and *Gmap* (23) modules have been used.
Has been created a new content type called "Sede" (location), and all information about locations have been linked to all "Sede" content with the *Gmap* module; all the sites nodes are displayed on a Google map by exploiting a plugin for Views module.

5. Conclusion and future works

In CNR@wOrK, nowadays, 133 users are registered from different parts of CNR. This is only the first approach to this complex and heterogeneous fields, but the platform has received several positive comments from users and external entities as ISTAT (Istituto nazionale di STATistica) . Users created groups, inserted news and official events and posted their opinion.

Figure 6 shows the access to the platform from January 2010 to April 2011.
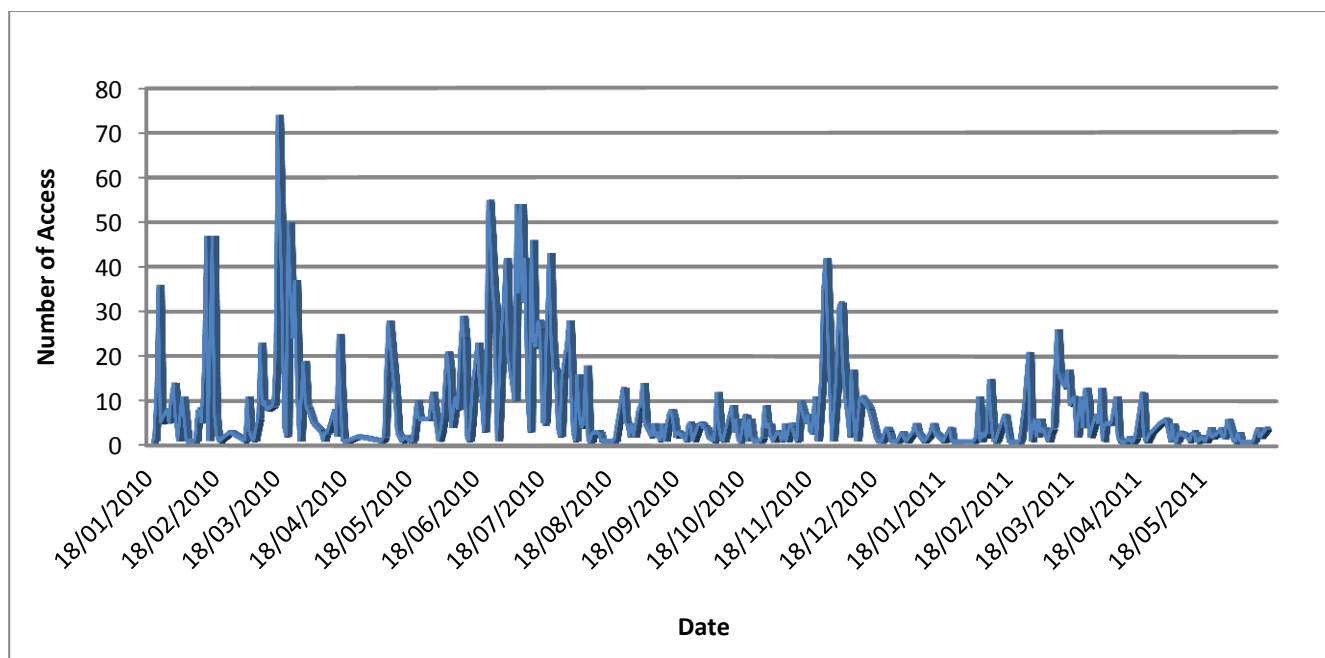
Figure 6 - Access to CNR@wOrK, January 2010 - April 2011

One of the biggest problem of the platform is the current relative low use. We can identify the three main causes: the inappropriate advertising, the lack of interest for the content and the perception of the platform as a beautiful but useless toy.
CNR@wOrK is a work in progress; many functionalities can be still added to increase the participation, such as:
- suggestion of colleagues with similar interests

- mechanism "I like it"
- scouting
- mechanism for scheduling meetings and other appointments (Doodle)
- video/photo posting Question & Answering (like Yahoo Answer)
- area for companies (like LinkedIn)

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