Towards Social Media Platform Integration with an Applied Gaming Ecosystem

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***Abstract*—The European (EU)-based industry for non-leisure games (so called Applied Games, AGs) is an emerging business. As such it is still fragmented and needs to achieve critical mass to compete globally. Nevertheless, its growth potential is widely recognized and even suggested to exceed the growth potential of the leisure games market. The European project Realizing an Applied Gaming Ecosystem (RAGE) is aiming at supporting this challenge. RAGE will help to seize these opportunities by making available an interoperable set of advanced Applied Game (AG) technology assets, as well as proven practices of using such AG assets in various real-world contexts. RAGE will finally provide a centralized access to a wide range of applied gaming software modules, relevant information, knowledge and community services, and related document, media, and educational resources within an online community portal called the RAGE Ecosystem. Besides this, an integration between the RAGE Ecosystem and relevant social network interaction spaces that arranges and facilitates collaboration that underlie research and development (R&D), as well as market-oriented innovation and exploitation will be created in order to support community building, as well as collaborative asset exploitation of User Generated Contents (UGCs) of the RAGE Ecosystem. In this paper, we will outline a conceptual approach exploring methods to first of all integrate Content Management- and Community Collaboration support including advanced portal features based on Digital Library (DL), Media Archive (MA), and Learning Management System (LMS) infrastructures with Social Network (SN) integration support technologies and on capturing support for Semantic Social Media (SSM) content. This will allow for a seamless integration of social network advantages within community portal operation. On the other hand it will support information, UGC, and knowledge sharing, as well as persistency of social interaction threads within Social Networking Sites (SNSs) that are connected to the RAGE Ecosystem. The paper reviews possible alternative architectural integration concepts, as well as related authentication, access, and information integration challenges. In this way, on the one hand a qualitative evaluation regarding an optimal technical integration approach is facilitated while on the other hand design approaches towards support features of resulting user interfaces are initiated.**

***Keywords*—Social Media; Applied Gaming; Digital Ecosystem; Access and Information Integration; Know-how transfer; Social Networking Site;**

I. INTRODUCTION AND MOTIVATION

The EU-based industry for AGs is an emerging business. As such it is still fragmented and needs to achieve critical mass to compete globally. Nevertheless, its growth potential is widely recognized and even suggested to exceed the growth potential of the leisure games market. The RAGE project [6] is aiming at supporting this challenge. RAGE will help to seize these opportunities by making available an interoperable set of advanced technology assets, tuned to applied gaming, as well as proven practices of using asset-based applied games in various real-world contexts. This will be achieved by enabling a centralized access to a wide range of applied gaming software modules, information, knowledge and community services, as well as related document, media, and educational resources within the RAGE Ecosystem. Furthermore, the RAGE project aims to boost the collaboration of diverse actors in the AG environment. Therefore, the main objectives of the RAGE Ecosystem are to allow its participants to get hold of advanced, usable gaming assets (technology push), to get access to the associated business cases (commercial opportunity), to create bonds with peers, suppliers, and customers (alliance formation), to advocate their expertise and demands (publicity), to develop and publish their own assets (trade), and to contribute to creating a joint agenda and road-map (harmonization and focus).

This means that seen as a whole, the RAGE project is a technology and know-how driven research and innovation project. Its main driver is to be able to equip industry players

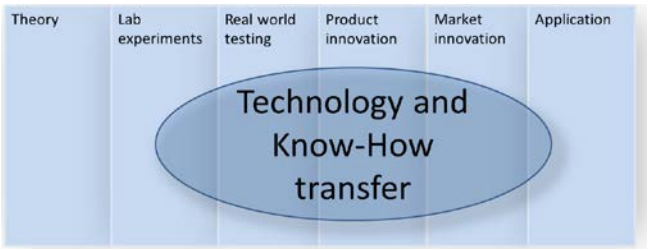

Figure 1. Technology and Know-How transfer [6]

(e.g., game developers) with a set of AG technology resources (so-called Assets) and strategies (i.e., know-how being provided by means of information services and knowledge resources) to strengthen their capacities to penetrate a market (non-leisure), which is new for most of them, and to consolidate a competitive position in it. Figure 1 represents the positioning of the project in the spectrum from 'theory to application'.

In consequence, the RAGE Ecosystem and its integration with social networks of game-research-, game-developing- , gaming-, and AG communities will on the one hand become an enabler to harvest community knowledge and on the other hand it will support the access of such communities to the RAGE Ecosystem as an information and knowledge resource.

Building on the results of this SNS integration with the RAGE Ecosystem including corresponding SNS-enabled content and knowledge management, the RAGE Ecosystem will in the future also support Social Network Analysis

 ISBN: 978-1-61208-443-5

(SNA) by means of applying technologies for Natural Language Analysis (NLA) for discourse analysis, as well as Named Entity Recognition (NER) and Semantic Representation and Annotation (SRA) of its results. This will, e.g., enable users to utilize the envisioned Ecosystem with features of a social mediation engine going beyond content syndication, i.e., it will serve as a social space that mediates collaboration partners, while content remains the main attractor. Finally, an interactive map of supply- and demand-side stakeholders and resources will be provided for domain and community orientation, as well as visual access support.

Firstly, section II provides a brief introduction of a set of exemplar target communities that are present in SNS. Furthermore the section III describes related researches. The section IV is about state of the art in science and technology. Section V, more specifically, reviews the integration possibilities of social network technologies and their interfaces that could possibly support integration with the RAGE Ecosystem. Furthermore, it will investigate how to support access to resources and assets from such SNSs. Additionally, in section VI, it will outline design approaches towards supporting users in the target communities by services provided by the RAGE Ecosystem by means of outlining several use case scenarios for using Social Networking Features (SNFs) within the RAGE Ecosystem user interfaces. Finally, it will present conclusions and future work.

II. TARGET SNS USER COMMUNITIES AND CORRESPONDING EXEMPLAR USER STEREOTYPES

As outlined above, the EU-based industry for AG is an emerging business, which is still fragmented and needs to achieve critical mass for global competition. The AG industry and developer groups want to keep their developments innovative, i.e., attractive and technologically in good condition. These groups already have a very good understanding of their competitive advantage and corresponding assets (e.g., software, documents, and social media objects, etc.). However, they also need innovative ideas to develop innovative AGs in order to stay competitive. Therefore, they look for possibilities to cooperate with AG Research and Development (R&D) groups. Besides this, the AGs that researchers create within research projects produce a lot of AG research assets and prototypes, which need to be fully developed and deployed by AG software developers to become marketable. Apart from AG developers and researchers, there are also AG customers and players who on the one hand want to learn about or contract the development of AGs and on the other hand can also contribute to the development of AG usage scenarios. Many of these communities (AG developers, researchers, customers and players) are already present in a fragmented way within several groups in several SNSs. In [21], there are some examples of AG research, as well as industry and developer communities in, e.g., LinkedIn and Twitter. The Applied Games and Gamification (AGG) LinkedIn group, see [24] has over 4,500 members and has been running since 2011. The group claims to be one of the largest collective of creators, developers, researchers and users of applied games and gamification globally. The typical users can be divided approximately into those from the industry and those from the academia. From professors and recent graduates in gaming and related technologies, to CEOs, founders and directors of a wide variety of organisation that work or research the domain. The majority of discussion posts are promotions of products, methodologies for design, reposts of other interesting blogs on the topic and individuals' thoughts on implications of games and gamification for learning, training and behaviour change. The most prolific posters tend to be consultants and individuals representing organisation that are looking to showcase their abilities to a more business oriented community toward winning more business. Many posts do not garner comments or discussion as they are often pointing to other resources; however posts which pose interesting questions do receive attention and lead to interesting discussions from the more active members. Similarly the Serious Games Group on LinkedIn, see [25], has over 5100 members and has been running since 2008. The group memberships somewhat overlap with the applied games and gamification, however the audience tends to be more focused on the learning solutions and learning providers, with fewer CEOs and marketing directors, and more game designers as compared to the AGG, although the mode of use are very similar.

RAGE will help to overcome this fragmentation and aims to support the capturing, as well as the representation, management, sharing, and exchange of social media produced content and knowledge resources through its Ecosystem. Therefore, the integration of SNSs hosting such target communities with the RAGE-Ecosystem and at the same time enabling the connectivity between SNSs and the RAGE-Ecosystem will connect research-, gaming industry-, intermediary-, education provider-, policy maker- and end-user communities. Furthermore, it will facilitate the centralized access to the valuable assets beyond the SNSs.

As a whole, take up of RAGE results will generate impacts that will be visible through multiple enhancements in the performance of European Applied Game industries, especially in terms of reducing the current fragmentation, improving their innovation capacity and fostering their progress towards global technological leadership. By offering reusable Applied Games assets, the RAGE Ecosystem infrastructure and marketplace will play a key role in support of applied research and technology development, including demand driven research and productification activities, easing technology transfer and field validation of novel products and services, on a broad collaborative basis. The combined effects will allow end-to-end Applied Games value chain players to dramatically improve their competitive position.

III. RELATED WORK

The work presented in this paper is related to a number of topics in research. The RAGE Ecosystem will be built upon the Educational Portal (EP) technology and application solution, which was developed by the software company GLOBIT [1] that already was used in APARSEN [2].

 ISBN: 978-1-61208-443-5

APARSEN (Alliance Permanent Access to the Records of Science in Europe Network) was an EU-funded project within the digital preservation area with the goal to create a virtual research center in digital preservation in Europe. The so-called EP tool-suite offers a wide variety of tools. This includes a web based, user-friendly User and Community Management (UCM) including an advanced Contact and Role Management (CRM) based on MythCRM [20], as well as knowledge management support in the form of Taxonomy Management (TM) support and semi-automatic taxonomy-based Content Classification (CC) support [3][16], as well as a Learning Management System (LMS) based on Moodle [4] and an advanced Course Authoring Tool (CAT) [23]. In this way, the Content & Knowledge Management (C&KM) tools of the EP tool suite support the management of documents in a taxonomy-supported Digital Library, the management of multimedia objects in a taxonomy-supported Media Archive and the management of Learning Objects in a competence-based Learning Management System [19]. Furthermore, one of its additional purposes is to support Continuous Professional Education (CPE) and training of practitioners, experts, and scientists, which are members of professional communities of practice or scientific communities. Figure 2 displays the components and services in the EP tool suite as described in [16]. EP was built based on Typo3 [1] and, therefore, can be extended with the help of Typo3 extensions. Evgeny, Bogdanov et al [11] extend a social media platform in higher education with lightweight tools (widgets) aimed for collaborative learning and competence development. Our work will establish the new EP module Community & Social Network Support with a so-called Agile Application Interface (AAPI), which facilitates the connectivity to a wide range of SNSs.

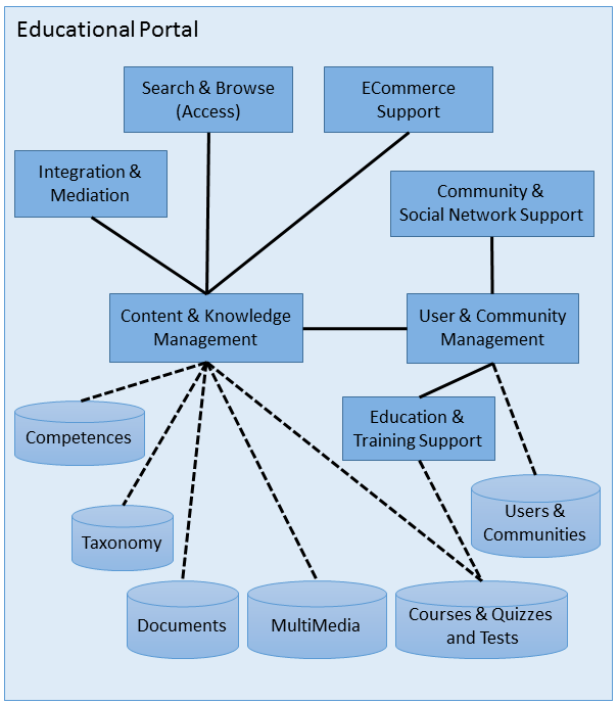

Figure 2. EP Tool Suite - Components and Services

IV. RELEVANT STARTING POINTS WITHIN THE STATE OF THE ART IN SCIENCE AND TECHNOLOGY

SNSs have changed the way of information sharing and learning processes by adding innovative features to social communication. SNS were defined as "*Internet or mobile-device based social spaces designed to facilitate communication, collaboration, and content sharing across networks of contacts. SNS allows its users to become content creators and content consumers at the same time, thus allowing instant participation, sharing of thoughts or information and personalised communication*" [7]. Therefore, SNSs are becoming increasingly important. This holds especially true for various SNFs like, e.g., rating, commenting, tagging, chatting, liking, posting new Social Media (SM) and UGC, following actors or celebrities, playing games etc. These SNFs are not only entertaining and exciting but also useful for learning and for information enrichment. Research has shown that distance education courses are often more successful when they develop communities of practice [10]. Besides, SM content becomes increasingly important in business and research. Kaplan [14] gave a clarification what the term SM means and how the concept of SM differs from the concept of related concepts such as Web 2.0 and UGC. Furthermore, he presents 10 pieces of advice to utilize SM. On the other hand, Agichtein et al [9] focus on the Semantic Social Media (SSM) and investigate methods exploiting community feedback, e.g., to automatically identify high quality content. Breslin et al. define in [12] "The Social Semantic Web as a vision of a Web where all of the different collaborative systems and social network services, are connected together through the addition of semantics, allowing people to traverse across these different types of systems, reusing and porting their data between systems as required." RAGE will use Semantic Web technologies in order to describe in an interoperable way users' profiles, social connections, and social media creation and sharing across different SNSs, as well as within the RAGE Ecosystem. Therefore, RAGE will be able to deliver well-grounded recommendation and mediation features AG R&D communities.

Today, most SNSs provide so-called Application Programming Interfaces (APIs) for developers to integrate the SNSs into their systems. Although, the SNSs are different in their functionality, i.e., their social networking feature support, their software architecture for the communication with distributed other systems is similar. Most of the SNSs offer REST APIs like [12][13][15], which can be used for integration with other systems. In the following, the description of the LinkedIn REST API software architecture as described in [7], as well as the Twitter Semantic REST API as described in [18] will be cited as an exemplary, illustrative, and at the same time representative example. The following features can be accomplished with the LinkedIn self-service APIs: Sign in with LinkedIn, Apply with LinkedIn, Share on LinkedIn and Manage Company Pages. One of the most important LinkedIn APIs is the share content. There are two methods for sharing content via the REST API [7].

- Post a comment that includes a URL to the content, which should be shared— LinkedIn analyzes the

 ISBN: 978-1-61208-443-5

TABLE I. TWITTERS REST API INSTANCES OF THE RESOURCETYPE CLASS [18]

ResourceType Instance	Description
Connections	Connections of the authenticating user to other users
DirectMessage	A private message sent from a user to another user
Entity	Metadata and additional contextual information about content posted on Twitter
EntityMedia	Media elements uploaded with a Tweet
FollowersIds	Numeric IDs of users that follow the authenticating user
FriendsIds	Numeric IDs of users that the authenticating user is following
TwitterList	A collection of tweets, posted by users belonging to a curated list
Trend	A popular topic in Twitter
UserCategory	Categeory of users
UsersLookup	Extended information about users

included URL and automatically identifies the title, description, image, etc.

- Share with specific values — developer should provide the title, description, image, etc., directly via the parameters of the API call.

Figure 3 displays a coding example for sharing content with specific values on LinkedIn [7].

The documentation of the Twitter API explicitly specifies four main response objects (Tweets, Users, Entities and Places) [22] but Togias et al. [18] identified with a more thorough study 44 of such resource types. Some of them can be directly accessed through actions provided by the API, while other can

```
{
"comment": "Check out
     developer.linkedin.com!", "content": {
    "title": "LinkedIn Developers Res.",
    "description": "Leverage LinkedIn's
       APIs to maximize engagement",
    "submitted-url":
    "https://developer.linkedin.com",
    "submitted-image-url":
    "https://example.com/logo.png"
  },
  "visibility": { "code": "anyone"}
}
```

Figure 3. Sharing content with specific values on LinkedIn

be accessed through the fields of other resource types. All of them defined the identified resource types as instances of *ResourceType* Class. Table I describes some of these instances in more detail.

In summary, it is a big advantage to aim at supporting the integration of SNSs including relevant SNFs, as well as SSM content capturing, management, sharing, and dissemination support through their REST API into the RAGE Ecosystem. This will on the one hand facilitate to extend the envisioned RAGE Ecosystem with features of a social mediation engine going beyond content syndication, i.e., it can serve a social space that mediates collaboration partners, while content remains the main attractor. On the other hand it focuses on identifying collaboration opportunities between individuals and among groups, to support matchmaking and collaboration between stakeholders, and to identify and provide support for innovation opportunities and creativity efforts. That allows communities (such as technology providers, game developers and educators, game industries, researchers) to create their own assets and post them to the Ecosystem's repository without major effort. Besides this, the above approach enables follow-up work in the area of social network analysis and discourse analysis, which can then be conducted and used to provide feedback, recommendations, mediations, and relevant information to the communities. This feedback can e.g., help gaming companies to develop new markets in applied gaming.

V. INTEGRATION APPROACH AND METHODOLOGY

The following section presents the main technical integration possibilities in the backend, as well as in frontend. In this way, our integration approach and methodology is enabling us to differentiate between how to get access to resources and assets in the RAGE Ecosystem from external SNS communities and how to push contents from the RAGE Ecosystem to the external SNSs in order to improve user acceptance of services provided by the RAGE Ecosystem. Figure 4 displays the concept of a bi-directional integration approach of the RAGE Ecosystem with SNSs using a REST API.

Corresponding to this bi-directional integration approach, table II details scenarios following possible Tight and Loose Coupling methodologies that have to be

Figure 4. Integration Approach of RAGE Ecosystem with SNSs

considered for achieving an integration of SNS to RAGE and vice versa. In the following, the description of the As Another example, the so-called SlideShare API and its software architecture as described in [8] will be cited in

TABLE II. LOOSE AND TIGHT COUPLING INTEGRATION METHODS BETWEEN SNS AND THE RAGE ECOSYSTEM

Method	FROM SNS TO RAGE ECOSYSTEM	FROM RAGE ECOSYSTEM TO SNS
Tight Coupling	Integration of RAGE-Interface within the SNS, user does not need to leave the SNS Environment (e.g., user posts a content to the RAGE Ecosystem without leaving the SN-Environment; user remains on the SNS)	Integration of SN-Interface within the RAGE Ecosystem, user doesn't leave the RAGE Environment (e.g., user posts, likes etc. a content without switching to the SNS; user remains on the RAGE Ecosystem)
Loose Coupling	SNFs are related to SNS (links from RAGE to the SNS) User lefts the RAGE Environment and switches to the SNS; user has to complete the action on the SNS, not on the RAGE Ecosystem	SNFs are only related to SNS (link from RAGE to the SNS) User leaves the RAGE Environment and switches to the SNS; user has to complete the action on the SNS, not on the RAGE Ecosystem

the following as an exemplary, illustrative, and at the same time representative example for the loose and tight coupling between the RAGE Ecosystem and SNSs.

The SlideShare API is based upon the REST model and supports the following functions:

- Upload, edit and delete slideshows
- Retrieving slideshow information by user, tag or group
- Retrieving groups, tags, and contacts by user
- Search slideshows

Those facilitate the loose coupling integration into the RAGE Ecosystem e.g., to get Slideshows by tag using the SlideShare REST API the Request should include followings parameter:

- Request Type: HTTPS GET
- Authorization: None
- URL: https://www.slideshare.net/api/2/get_slideshows_by_tag
- Tag: tag name
- [limit: specify number of items to return]
- [offset: specify offset]
- [detailed: Whether or not to include optional information. 1 to include, 0 (default) for basic information.]

The Slideshows REST API Response is in XML format and it looks like the following coding:

```
<Tag>
  <Name>{ Tag Name }</Name>
  <Count>{Number of Slideshows}</Count>
  <Slideshow>
  { as in get_slideshow }
  </Slideshow>
...
</Tag>
```

Furthermore, SlideShare provides an oEmbed API, which follows the oEmbed [5] standard. This standard facilitates the tight coupling integration of the Slideshows within the RAGE Ecosystem. The following codes show an example for making the embeddable media available through its oEmbed API endpoint and an API response example.

1. Example: XML Request

```
http://www.slideshare.net/api/oembed/2?
url=http://www.slideshare.net/
haraldf/business-quotes-for-
2011&format=json
```

2. Example: XML Response

```
{ The oEmbed version number }
{ Media type }
{ Embed media height }
{ Embed media width }
{ Embed content provider, SlideShare }
{ URL of the provider }
{ Thumbnail URL }
{ Thumbnail height}
{ Thumbnail width}
{ Author of embed content }
{ oEmbed version number }
{ Author SlideShare homepage }
{ ID of the slideshow }
{ Total number of slides in slideshow}
{ base URL of the slideshow images }
{ base URL suffix }
{ version number of the slideshow }
```

VI. SNF USAGE SCENARIOS AND DESIGN CONCEPT

In addition to outlining our SNS integration approach and methodology, Figure 5 displays how the SNS usage scenarios can be integrated into the RAGE Ecosystem itself. RAGE Ecosystem users can visit content and knowledge management support within the RAGE Ecosystem's a Digital Library, Media Archive, Software Repository, which is currently under development based on [17], and Learning Management System. Here, users have the opportunity to:

 ISBN: 978-1-61208-443-5

a. Rate **(1)**, like **(2),** and Comment **(3)**: these Social Networking Features (SNFs) are e.g., important for the recommendation system (also currently under development, see [16] to get more useful suggestions.
b. Tell a friend **(4)**: users can send links to selected content (or the content itself) through email. Email addresses can be selected either from the RAGE address book or from users' address books, which are located in SNSs.
c. Share and post **(5)**: Users can share the selected content to one of their favourite SNSs or on the fly to more than one by selecting them from the share button.
   Users also have the possibility to publish content to a repository (e.g., GitHub's repository) or to cloud storage (e.g., into Dropbox).
d. Favourite **(6)**: Users can add content to their favourite lists, which facilitates to later, e.g., share/post their entire favourite list to a community.
e. Share and post to RAGE Communities **(7)** within the RAGE Ecosystem and also from any other platforms outside the RAGE Ecosystem. A RAGE Share-Button can be released and, e.g., be integrated by developers into other portals, homepages, ecosystems etc. to provide the possibility to Internet Users to share and post their content to the RAGE-Ecosystem.
f. RAGE Follow-me **(8)**: RAGE users can follow other users, groups or content in order to keep themselves up-to-date.

VII. CONCLUSION AND OUTLOOK

In this paper, we have introduced the RAGE Ecosystem supporting community-based content and knowledge management. In detail it will support the collection, sharing, access, and re-use of AG R&D assets, including SSM content and UGC resources, as well as academic, industry, and end user best practice knowhow represented in corresponding knowledge resources. In this way, the RAGE Ecosystem will provide AG communities, and therefore SNS communities, too, an opportunity to interact, share and re-use SSM content and UCG including corresponding knowledge resources, as well as communicate and collaborate using the RAGE Ecosystem as a back-end community content and knowledge management portal in addition to their favorite SNSs. Besides this introduction, we have presented how a technical integration between the RAGE Ecosystem and SNSs can be achieved to reduce the fragmentation and to increase the knowledge exchange among AG communities (such as AG developers, researchers, customers, and players). The RAGE Ecosystem and its SNS and SNF integration are currently under development. In the future, RAGE is aiming at increasing outreach and take-up of the RAGE Ecosystem through further SNS integration and SNF implementation.

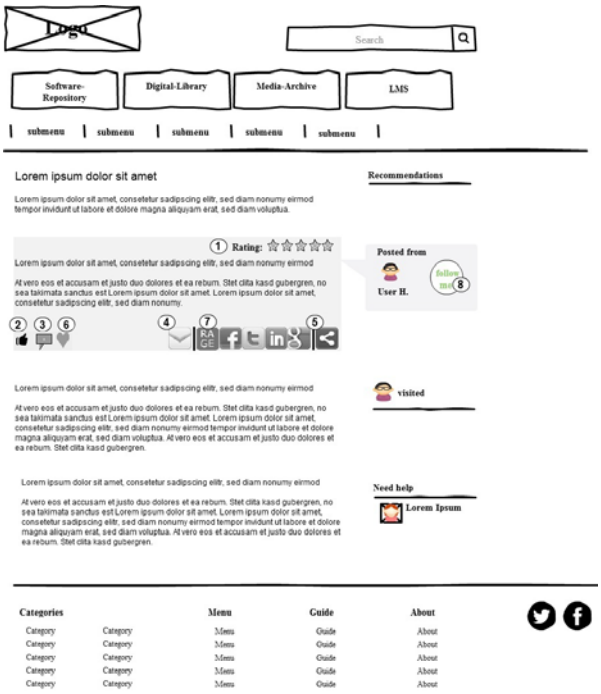

Figure 5. SNF Usage Scenario in the RAGE Ecosystem

For example, the SNA and discourse analysis will be used for collecting, analyzing, and presenting data about various patterns of relationships among people, objects and knowledge flows within the RAGE Ecosystem and will provide additional functionality and sophisticated services for end-users, enhancing the emergence of communities. In particular, future developments will focus on identifying collaboration opportunities among individuals and groups, to support matchmaking and collaboration among main stakeholders, and to identify and provide support for innovation opportunities and creativity efforts. In this way, the RAGE project currently anticipates the following tools and services:

a) The RAGE Diagnostic tool based on various metrics for analyzing the usage of resources, the formation of different users groups, the level of social interactions, etc.,
b) the RAGE awareness tool can increase participation of different target groups in the Ecosystem,
c) the RAGE Knowledge Mapping tool builds and analyses knowledge maps for all kind of resources available in the Ecosystem.
d) the RAGE Professional support tool will support the users by letting them know whom or where to ask for support in different situations,
e) the RAGE Community detection tool will use available clustering algorithms (also called ''community detection algorithms'') that automatically identify and locate existing communities, in order to enhance the communication between gaming practitioners,
f) the RAGE Ecosystem analysis tool will apply network

 ISBN: 978-1-61208-443-5

analysis including many algorithms for identifying the most important, or central in some sense, nodes within a network,

g) the RAGE Recommendation may generate value interventions towards stimulating the participation of users. Such interventions include suggesting connections among users, setting up groups, closing the gaps in people's knowledge of other members' expertise and experience, and strengthening the cohesiveness within existing teams. Social media data such as tags, comments, purchasing patterns, and ratings can be used to link related gaming assets and users together into networks, the RAGE Social learning tool applies SNA to online learning environments, as well, focusing on the structural relationships between all learning objects and users, that support learning communities.

With the design and development of a comprehensive approach as pursued with the RAGE Ecosystem, ethical issues need to be taken into account. The integration of users' SN profiles from different SNS, as well as the use of features carrying out analyses on top of Ecosystem user data have ethical implications in terms of privacy and data protection and require appropriate information and consent in the terms and conditions of use, as well as compliance to national and international data protection regulations. The same is for any use of log data for the purpose of system evaluation, or for UGC and user actions shared among different SNS and the RAGE Ecosystem. In addition, with UGC questions related to verification and validation of contributions, as well as to copyright ownership and infringement become relevant. The consideration of such ethical and legal requirements shall be incorporated in the system design and development process in terms of an ethics-by-design approach [26]. This means that data protection and privacy is already taken into account when the system is being designed. Design principles, such as purpose binding, would ensure that personal information is only accessible, if there is a need for it when performing a certain action. The system can also control data access by respecting personal settings which data should be available to others or the public. Other ethics-enabled features include the modification or deletion of personal data.

ACKNOWLEDGEMENTS AND DISCLAIMER

This publication has been produced in the context of the RAGE project. The project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 644187. However, this paper reflects only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

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 ISBN: 978-1-61208-443-5