

Enhancing Knowledge Management and Transfer in an Applied Gaming Ecosystem

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Enhancing Knowledge Management and Transfer in an Applied Gaming Ecosystem

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ABSTRACT

The European (EU)-based industry for non-leisure games (Applied Games, AGs or formally called serious games) 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. To become competitive the relevant applied gaming communities require support by fostering the generation of innovation potential. The European project Realizing an Applied Gaming Ecosystem (RAGE) [1] 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 asset-based AGs in various real-world contexts. As described in [2], RAGE will finally provide a centralized access to a wide range of applied gaming software modules, relevant information, knowledge and community services, and related scientific documents, taxonomies, media, and educational resources within an online community portal called the RAGE Ecosystem. This Knowledge Management Ecosystem (KM-ES) is based on an integrational, user-centered approach of Knowledge Management (KM) and Innovation Processes in the shape of a service-based implementation [3]. In this paper, we will describe the integration of the Scientific Publication and Presentation Platforms (SPPs) Mendeley [4] and SlideShare [5] into the RAGE Ecosystem. This will support information, User Generated Content (UGC), and knowledge sharing, as well as persistency of social interaction threads and Know-how transfer within Social Networking Sites (SNSs) and Groupware Systems (GWSs) that are connected to the RAGE Ecosystem. This paper reviews relevant use cases and scenarios, as well as related authentication, access, and information integration challenges, besides this, it shows the basic considerations influencing the Ecosystem concept and development as well as the economic potential of Ecosystems and the importance of KM and Know-how transfer in the execution of innovation and value added processes.

KEYWORDS

Knowledge Management; Know-how Transfer; Service Management; Innovation; Social Networking; Applied Gaming; Digital Ecosystem; Access and Information Integration; Scientific Publication and Presentation; Mendeley; SlideShare

1. INTRODUCTION AND MOTIVATION

The EU-based industry for 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. Though, the launch of innovative products for SMEs of the AG industry constitutes an enormous challenge considering the global competition combined with limited budgets. They need strategies to have the crucial competitive advantage of being faster than others [7], [8]. Accelerating the discovery of new (scientific) findings, the technical realization and the market launch [8], [9] is increasingly dependent on the use of advanced information and knowledge technology for building environments that support the innovation process systematically and efficiently [10]. Such environments depend on a number of advanced (KM) technologies and processes and have to adapt to a wide variety of innovative practices, cultures, organizational context and application areas, where innovation takes place. Independent of the domain, innovation is a knowledge-intensive process. [7] The RAGE project [1] 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 AG, as well as proven practices of using asset-based AGs in various real-world contexts. This will be achieved by enabling a centralized access to a wide range of AG software modules, information, knowledge and community services, as well as related documents, publications, media, and educational resources within the RAGE KM-ES. Furthermore, the RAGE project aims to boost the collaboration of diverse actors in the AG environment. The main objectives of the RAGE KM-ES 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). Therefore, 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 (e.g., game developers) with a set of AG technology resources (so-called Assets) and strategies (i.e., know-how) to strengthen their capacities to penetrate an almost new market (non-leisure) and to consolidate a competitive position. Figure 1 represents the positioning of the project in the spectrum from 'theory to application'.

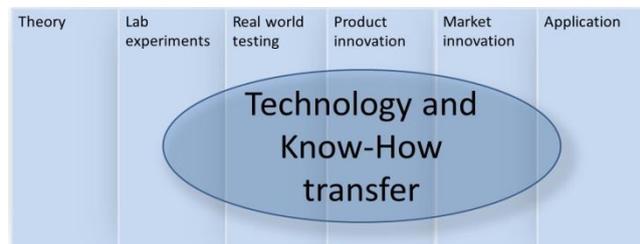


Figure 1: Technology and Know-How transfer [6]

In consequence, the RAGE KM-ES 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 to the RAGE KM-ES as an information and knowledge resource for such communities.

The AG sector as an upcoming business market is at present characterized by weak interconnectedness, limited knowledge exchange, absence of harmonising standards, limited specialisations, limited division of labour, and insufficient evidence of the products' efficacies [11], [12]. The industry is scattered over a large number of small, diverse, independent players, niche products and of course specialists. Because of limited collaborations of industries and limited interconnections between industry and research, applied gaming companies display insufficient innovation power and size to open up new markets (e.g. schools, business, governments) [11], [13]. To support the development and growth of this branch the RAGE KM-ES will foster the merging of the heterogeneous AG communities by providing an effective knowledge and innovation management service tool.

As a single entry point for AG, the RAGE KM-ES will realize centralized access to a wide range of AG software modules, services and resources by the arrangement of a well-managed and structured asset repository, digital library, and media archive system. The resulting material in the Ecosystem, particularly the textual resources, will be semantically annotated to support searching and access. Therefore, Social Network

Analysis (SNA) by means of applying technologies for Natural Language Analysis (NLA) for discourse analysis will be used. Besides, the Ecosystem will arrange workshops and offer training courses on an online training portal, covering training for developers and educators in order to amplify applied gaming uptake. The aim will be to support the self-sustainable production of assets and documentation, training material, workshops and collaboration activities. In addition the social dimension of the RAGE KM-ES will be supported by community tools for collaboration, annotation, creativity and matchmaking [6]. Furthermore the Ecosystem will serve as an interactive knowledge and content management platform and provide a diverse set of services across the knowledge value chain [6].

In the remainder of this paper, Section 2 describes related work to similar Ecosystems based on (KM) and Innovation Processes. Section 3 provides a brief introduction of the digital Ecosystem environment from knowledge and service driven perspectives and introduces a set of exemplar target communities that are present in Social Networking Sites (SNSs) and Groupware Systems (GWSs). Furthermore, Section 4, more specifically, reviews the integration possibility of Mendeley [14] and SlideShare [15] into the RAGE KM-ES using their Application Programming Interface (API). Furthermore, this section will investigate how to support a bi-directional access to resources, assets and community information between the RAGE KM-ES and such SNSs and GWSs. Finally, the paper will present conclusions and future works.

2. RELATED WORK

The work presented in this paper is related to a number of topics in research. The conceptual approach of the Ecosystem is based on the reflections of KM [16]–[18] and Service Management [19], [20]. Building on the SEKI model from Nonaka und Takeuchi [21], the Innovation Knowledge Lifecycle Meta Model (IKLC) extends the basic model inter alia by the factor innovation [7], [22]. Furthermore the conceptual approach and benefits of Communities of Practice (CoP) by Lave and Wenger [23] and the extensions to online CoPs (OCOPs) [24] respectively virtual CoPs (VCoPs) [25] and the linking to KM [26] are taken into account. Defined by people, especially practitioners, in a shared domain engaging in a process of collective learning [27], the RAGE KM-ES is creating and supporting the digital environment for a VCoP in the domain AG to enable successful asset-based (serious) game development and commercialization. Successful examples are the Community Grids for Learning (CGfL) [28], the NSW CoP for ICT professionals [29] or the IBM CoPs [30].

A well-known similar Ecosystem that is not especially focused on the domain of AG is GitHub [31].

GitHub is a software development Ecosystem which currently has over 10 million users. Users can upload or start a software project and collaborate on its development with other users in the community [32]. Currently active and past projects are retained and can be used as examples and sources of knowledge. GitHub demonstrates that an Ecosystem with a partial overlap of features to the RAGE KM-ES, but with a different domain, can be successfully adopted as collaboration environments.

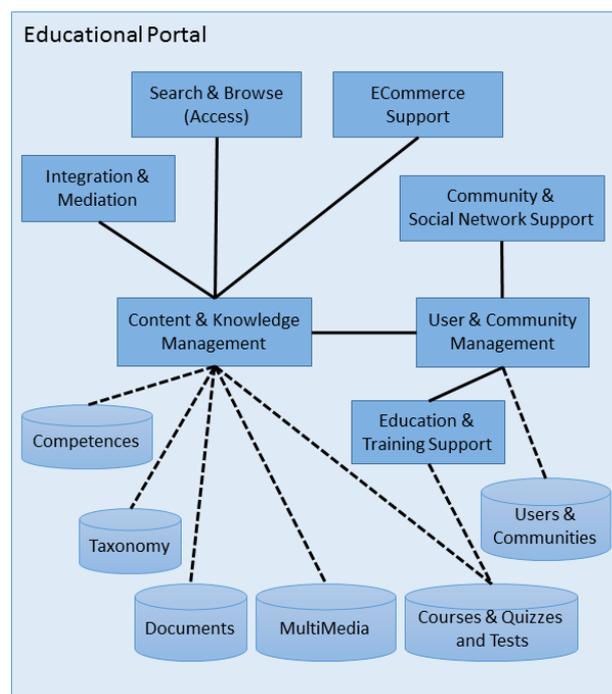


Figure 2: EP Tool Suite - Components and Services

Another example for empirically supporting the potential of the RAGE KM-ES is the GALA project. The GALA project involves 31 European institutions and facilitates the cultivation and dissemination of academic applied games knowledge [33]. The GALA project resulted in a successful conference; a scholar.google search reveals 37 publications for 2014 as well as a host of GALA related research. One of the relevant differences between RAGE and GALA is that RAGE aims to facilitate the business market rather than the academic community. However, both RAGE and GALA have overlap in residing in the domain of applied gaming.

The RAGE KM-ES will be built upon the Educational Portal (EP) technology and application solution, which was developed by the software company GLOBIT [34] that already was used in the Alliance Permanent Access to the Records of Science in Europe Network (APARSEN) [35]. The so-called EP tool-suite offers a wide variety of tools and is currently extended by Research Institute for Telecommunication and Cooperation (FTK) within the RAGE project into an Ecosystem Portal (EP) tool suite [36]. This includes a web based, user-friendly User and Community Management (UCM) including an advanced Contact and Role Management (CRM) based on MythCRM [37], as well as Knowledge Management support in the form of Taxonomy Management (TM) support and semi-automatic taxonomy-based Content Classification (CC) support [38], [39], as well as a Learning Management System (LMS) based on Moodle. Figure 2 displays the components and services in the EP tool suite as described in [38]. The EP was built based on Typo3 [34] and, therefore, can be extended with the help of Typo3 extensions. Our work will establish the new EP module Community & Social Network Support (CSNS) on the basis of a so-called Agile Application Programming Interface (AAPI), which facilitates the connectivity to a wide range of SNSs and GWSs.

3. THE DIGITAL ECOSYSTEM ENVIRONMENT AND CORRESPONDING COMMUNITIES

The concept of a supporting tool for innovation processes by creating an adequate environment considering incoming needs and demand, working knowledge processes and the satisfied demand based on innovative outcome has been extended to the concept of the RAGE KM-ES. Located in the AG domain and the corresponding communities (applied game developers, game based learning initiatives, etc.), the environment has to take different perspectives and “languages” into consideration, because each community or domain is assumed to have its own shared context. Even in the field of AG the different perspectives or interpretations across communities have an impact on the performance of the whole innovation knowledge lifecycle process [40]. Looking at the considerations in the context of CoP, thereby the establishment and development of a virtual community of practice in the domain of AG will be supported. Beside the interest in AG and the mutual engagement in joint activities and discussions, the users respectively members of this CoP will be supported to build relationships that enable them to learn from each other. The shared practice will be the development of a shared repertoire of resources, like assets and accompanying documents, experiences, tools or ways of addressing recurring problems. [41], [42]

Knowledge driven approach

Taken the SEKI and IKLC considerations into account [3], the KM process could be described as follows. Driven by the need for competitive products and services, responsive to the customers fast changing requirements the AG industry indicates a high demand of innovation. To establish an appropriate environment and kind of a body of knowledge the Ecosystem will collect media resources as well as documentation, training material and best practices from the heterogeneous and dispersed AG landscape to provide relevant communities the opportunity to participate, to share and to benefit from these resources to create new and innovative outcomes. To handle the available domain specific tacit knowledge within a technology based infrastructure it must be transformed into machine-readable shape. Therefore the applied gaming users or user groups have to transform their communication, information and experiences into digital objects (text, image, video, recorded speech ...) and provide them to the related AG communities. The RAGE KM-ES will serve as a platform for this kind of provision. The service can be described as Externalization. In the next step a Combination process of merging existing, explicit knowledge from different domains (e.g., Research, Development and Education) generates new information in the context of AG. As one of the features of the Ecosystem, the digital objects will be annotated with semantic representations. Consequently this implies an enrichment of objects with a common framework of understanding, to solve problems of different perspectives or understanding as described above. As one result a systematic search and analysis of objects and resources will be possible. Thus, the Ecosystem supports its users to find content arose from tacit knowledge with explicitly annotated semantic representations and to adapt, extend and link it to internalize this knowledge (Internalization). This step is called cognitive value creation or the generation of knowledge [22].

Connecting to this process the attached Educational Portal offers internalization resp. knowledge transfer in

the sense of a learning management process. It serves as a huge knowledge library or database. The learning objectives of a user could be annotated, based on his profile, so that this annotations will be available as knowledge in the system additionally. A test / exam can then decide what content needs to be learned in order to achieve the learning objectives and which competences already exist and may be assigned to the users profile.

Service driven approach

Taken this features of the RAGE KM-ES into account the Portal is integrating streams of the demand and supply side. Users will be able to inquire community specific knowledge, to search and access knowledge, to consume knowledge and information (e.g., online training courses) and they will be able to produce new media objects and knowledge in various ways.

Thus, the offered features received a service character. In this case knowledge represents an intangible commodity and the result of the service process has intangible character. The process could be highly

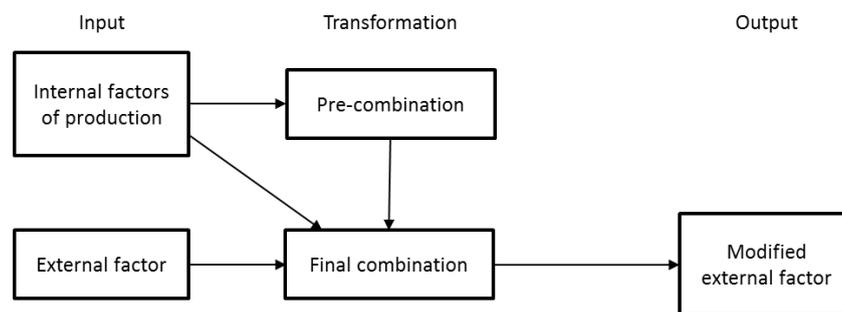


Figure 3: Service Production Phase Model [20]

integrative, if the customer, frequently the user itself, will be integrated into the preparation constantly [19]. An advantage of the system lies in the automated execution of the described service processes, the KM-ES can act efficiently and independently and provide automated services.

Considering the Service Production Phase Model (cf. e.g., [20], [43]) KM within the Ecosystem environment will be affected through internal and external factors (cf. Figure 3). The internal factors may be tacit knowledge and experiences of the AG users or other internal knowledge carriers, the explicit knowledge of already existing recourses and assets organized in the Ecosystems content management infrastructure, the ambition and motivation to create something new and the users' capacity. In addition expert knowledge, information and expertise from outside the direct user community have to be taken into account as well as community collaboration support.

The users or user groups will produce a pre-combination of knowledge by combination and integration of content and their experiences from different domains and will supplement this by consultation of external experts or social communities.

The final combination will be resulting by including the customer to the service production process. The customer in this demonstrated knowledge production process will mainly be the user itself. He will enter the Ecosystem because of his special demand of knowledge and will trigger the knowledge creation process in different ways. Maybe he will inquire more competencies in the field of AG by entering to an online training course or he will inquire a new AG asset and will collaborate with other software developers or he will just learn from the best practice knowhow to create a new idea and bring it efficiently into the market afterwards.

The KM-ES will create value or value potential only when it is filled up with content and knowledge resources and will be used by the AG related communities. Therefore the development approach is a phase-oriented user-centered and agile process, involving different stakeholder groups step by step. In a first step the researcher requests and requirements out of the RAGE consortium will be integrated. Thereafter the game development companies will be involved and in the third step the application partners will be integrated to improve the system. These groups are representing so called user stereotypes with different interests, experiences and skills. Beyond the RAGE consortium mainly already existing AG communities should be addressed in order to connect and share their knowledge and UGC within the Ecosystem. These user groups are already familiar with the terminology in the range of AG, are already using service-oriented platforms and thus have a lower entry barrier in a new, overarching Ecosystem. In consequence, the integration with SNSs and GWSs of game-research-, game-developing-, gaming-, and AG communities is highly necessary and

become an enabler to harvest community knowledge. On the other hand it will support the access of such communities to the RAGE KM-ES as an information and knowledge resource.

Corresponding communities

Exemplary target communities which are present in SNSs and GWSs could be described as follows. The Applied Games and Gamification (AGG) LinkedIn group [44] 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 distinguished roughly into those from industry and those from academia, i.e., 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 (SGG) on LinkedIn [44] has over 5200 members and has been running since 2008. Another AG research group example is the Game Research (GR) Mendeley group which has more than 140 members and more than 200 papers. 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.

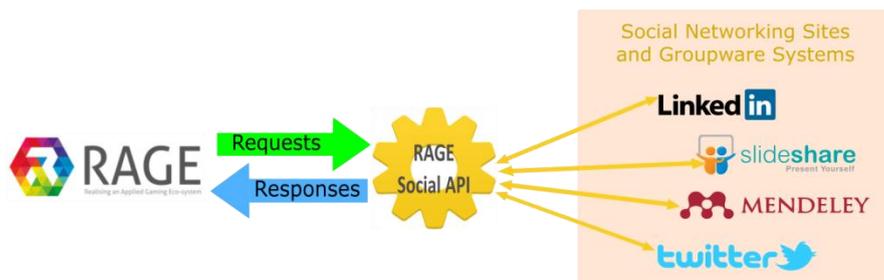


Figure 4: Integration Approach of the RAGE KM-ES with SNSs and GWSs

4. INTEGRATION APPROACH AND IMPLEMENTATION

The following section presents the main technical integration possibilities in the backend, as well as in the 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 KM-ES from external SNSs and GWSs communities and how to push contents from the RAGE KM-ES to the external SNSs and GWSs in order to improve user acceptance of services provided by the RAGE KM-ES. The description of the Mendeley and SlideShare API software architectures as described in [14], [15], [45] will be cited as an exemplary, illustrative, and at the same time representative examples. Figure 4 displays the concept of a bi-directional integration approach of the RAGE KM-ES with SNSs (e.g. LinkedIn and Twitter) and GWS (e.g. Mendeley and SlideShare) using a REST API.

Corresponding to this bi-directional integration approach, the Tight and Loose Coupling methodologies, as described in [46], will be considered for achieving an integration of SNSs and GWSs into the RAGE KM-ES.

The Mendeley API is based upon the following standard:

- RESTful using the base URL: <https://api.mendeley.com>.
- JSON: The response data is delivered in JSON format.
- HTTPS: All requests must be send using TLS/SSL connections.
- OAuth 2.0 is used to authenticate and authorize all Mendeley API requests.
- CORS: Cross original resource sharing is enabled on all API requests. CORS is a mechanism to enable client-side cross-origin requests [47].

Each Mendeley's resource is identified by a URL path. There are many types of data available but the principal resources include [4]:

- Document: User Documents created by Mendeley users and assigned to either Libraries or Groups.

- Catalog: Catalog Documents from Mendeley's crowdsourced collection of papers.
- Files: File attachments associated with user documents.
- Groups: Collaborative users form a group for sharing documents and ideas.
- Annotations: Users mark up and comment in documents and files using annotations.

The following code illustrates an example for capturing data from the Mendeley System into the RAGE KM-ES using the Mendeley JavaScript Software Development Kit (SDK) [45]. Each call will either resolve with some data or reject with the original request and the API response.

```
MendeleySDK.API.documents.list().done(function(docs) {
    console.log('Success!');
    console.log(docs);
}).fail(function(request, response) {
    console.log('Failed!');
    console.log('URL:', request.url);
    console.log('Status:', response.status);
});
```

The SlideShare API, similar to the Mendeley API, is based on the REST model, JSON, HTTPS, and OAuth 2.0. It supports the following actions [15]:

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

All SlideShare API requests must have the following parameters[15]:

- api_key: The API Key that SlideShare has provided for you.
- ts: Set this to the current time in Unix TimeStamp format, to the nearest second().
- hash: Set this to the SHA1 hash of the concatenation of the shared secret and the timestamp.

The following code presents an example for capturing Presentations (SlideShow) by user.

The integration of the Scientific Publication and Presentation Platforms (SPPs) Mendeley [4] and SlideShare [5] into the RAGE KM-ES facilitates the seamless integration of relevant Social Networking Features (SNFs) and

```
function getSlideShowByUser($username = null, $password = null){
    $ts = time();
    $hash = sha1(client_secret.$ts);
    $client_id = $this->get_client_id();
    $result = 'https://www.slideshare.net/api/2/get_slideshows_by_user?'.
        'api_key='.$client_id.'&hash='.$hash.'&ts='.$ts;
    if (isset($result['Slideshow']['ID'])) {
        $result['Slideshow'] = array($result['Slideshow']);
    }
    return $result;
}
```

Groupware Features (GWFs), such as (rate, like, comment, share, post, etc.) as described in [46].

5. CONCLUSION AND OUTLOOK

In summary, it is a big advantage to aim at supporting the integration of SNSs and GWSs (e.g. LinkedIn, Mendeley, SlideShare, etc.) including relevant SNFs and GWFs, as well as UGC capturing, management, sharing, and dissemination support through their REST API into the RAGE KM-ES. This will on the one hand facilitates to provide a wide range of supporting services in the field of knowledge transfer and -creation to overcome low market access and small market share of small and medium sized companies in the AG market, to create new effective technology based assets in order to build new ingenious learning games. 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 and researchers) to engage themselves in a VCoP, create their own assets and post them to the Ecosystem's repository without major effort and to benefit from achieving (business) results.

The innovation potential of the new platform based knowledge added value process underlies the following factors: a huge, mostly entire collection of community specific knowledge (e.g., content like media objects, software components and best practices), a structured approach of knowledge access, search and browse, collaboration tools as well as social network and discourse analysis tools to foster efficient knowledge creation and transformation processes into marketable technology assets. Consequently these new assets will be used to produce new applied games or game based learning applications. Hence, the developed knowledge will be economized and could be monetarily evaluated at the market. Therefore knowledge becomes an economic asset itself and the process of knowledge creation becomes a value added service. The challenge will be to build up a sustainable, accepted and trusted environment, with somebody taking the lead and responsibility for the KM-ES (cf. e.g., [25]).

With the design and development of a comprehensive approach as pursued with the RAGE KM-ES, ethical issues need to be taken into account. The integration of users' SN profiles from different SNSs, 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 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 [48]. 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.

The RAGE KM-ES supports therefore the interconnectedness, the knowledge exchange and the harmonization of standards of the applied gaming branch. Coupled with suitable business models the RAGE KM-ES could help the AG industry to drive strategy, support problem solving, build capabilities and knowledge competencies, cross fertilize ideas and increase opportunities for innovation to assert themselves against big games companies [42] [49].

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