Inf Syst Front (2017) 19:253–266
DOI 10.1007/s10796-016-9682-6

Integrating data from user activities of social networks into public administrations

Marcel Rosenberger[1] · **Christiane Lehrer**[1] · **Reinhard Jung**[1]

Published online: 25 July 2016
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Abstract Linking social networks with government applications promises various benefits, such as improving citizens' public engagement, increasing transparency and openness in government actions, and new or enhanced government services. The research goal is to drive innovation in governments through the integration of user activities from social networks into government applications. Instead of using third-party social media tools, we call for self-developing integration software, so that the government retains full control of the sensitive government data that is linked to social network user data. Following a design science approach, we developed a data model of user activities in social networks. Our 40 user activity types conceptualize the common fundamental data structure and are a means for comparing current features of ten prominent social networks. We find that a substantial share of user activities can be mutually integrated by wrapping social network Application Programming Interfaces (APIs).

Keywords Social networks · User activities · Integration · Open data · Government

✉ Marcel Rosenberger
marcel.rosenberger@student.unisg.ch

Christiane Lehrer
christiane.lehrer@unisg.ch

Reinhard Jung
reinhard.jung@unisg.ch

[1] University of St. Gallen, St. Gallen, CH, Switzerland

1 Introduction

Social networks have become a truly conspicuous part of society and many governments now devote considerable attention on the use of such social media in the public sector (Sivarajah et al. 2015, p. 1). Bertot et al. (2012), p. 31) predict that their role will become even more important within a very short period of time. The increasing number of active users in social networks creates opportunities for governments, which range from open policy making to communication campaigns and citizen service (Pirolli et al. 2010, p. 20; Bertot et al. 2012; Criado et al. 2013, p. 319).

Our goal is to support innovation in governments and help provide new or better services through connecting social networks with government applications. Examples include forecasting the necessary police resources for (announced) demonstrations, based on activist activities posted in social networks, obtaining direct feedback about town planning, detecting acts of discrimination and fraud, and creating innovative ways of providing information for citizens' requests. Traditionally, the migration of a citizen to another city requires visits to the authorities for various reasons. Precisely because the person who has moved is new to the city, it is not always easy to find the right places for the different matters (e.g. notification of change of address, car registration, children's school registration). Additionally, the person has to manage many other things at the same time (e.g. change of employment, renovation of the new home, and even language courses). Municipalities could offer better service by recognizing a new citizen automatically, based on a change in the home town attribute on the user's social network profile and then sending him/her helpful information on what to do when, how and where. Another opportunity is to detect current topics that are related to the public administration, based on key words in user posts in social networks. For example, refuse

collection could detect posts containing "garbage" or "trash" or "litter", in combination with the name of locations in a specific city and reply with the dates of the next garbage pick-up cycle or schedule an extra pick-up service where necessary. Lost items could be photographed and published in social networks, so that owners might be found fast through word-of-mouth. We respond to Bertot et al. (2012), p. 36) call for more research that focusses on making use of citizen feedback in social media. Dinter and Lorenz (2013, p. 10) identify data architectures, data models, and implementations as appropriate research artifacts for driving solutions forward. Bonsón et al. (2014), p. 52) state that the combination of e-government and social media, and foremost social networks, has become "a powerful strategy for administrative reform at all levels of government". In particular, many citizens expect "that government agencies will be accessible via social media technologies" (Jaeger and Bertot 2010, p. 31). Forums, blogs, wikis, chats and social networks are prominent types of social media technology. Forums allow citizens to discuss views about many different topics and to develop new ideas collaboratively with officials. For example, municipalities could publish recent developments, news, events and obtain intermediate results on blogs and receive comments from citizens. These short posts keep interested parties up-to-date and encourage readers to provide feedback. Wikis serve as a knowledge platform on which multiple users create contents collaboratively. For example, cities could themselves list points of interest and invite visitors to enhance the list with their own ideas and photos. Many social networks combine features which are typical of other social media types (e.g. chats and blogs), and offer functionality to connect/link users to other users. In our study, we focus on social networks, because they are probably the most widespread social media technologies in bureaucracies (Criado et al. 2013, p. 323; Oliveira and Welch 2013, p. 398). Criado et al. (2013) find that the public sector could benefit substantially from the large amount of data from the interaction with citizens, businesses, and other public administrations in social networks. They conclude that the goals associated with government social media applications in governments are predominantly oriented to innovation through dialogue with citizens. In particular, data from user activities are relevant for public organizations, because they make recognizing and analyzing citizens' responses, opinions, and interests possible in the first place and enable linking these with other government data.

An (automated) integration solution helps to identify relevant user activities, process the related data and link it to existing government data, which, due to the vast amount of data, cannot be done manually (Smith 2009; Bertot et al. 2010a, p. 268; Zuiderwijk et al. 2015, p. 1). Examples of user activities include joining groups, placing like- or dislike flags, adding others to one's friend list, reading specific government posts and watching videos. Despite the consensus among various authors, who emphasize that IS play an important role in integrating social networks with government applications, surprisingly little research has been conducted to help governments implement these integration solutions. One reason might be that social media in government is still in its infancy and that "some of the risks and problems associated with the implementation [of integration solutions] are just beginning" (Criado et al. 2013, p. 325). Some pilot projects have been conducted in policing, healthcare regulation, and fraud detection among other domains. People's privacy is a major concern in these initiatives, in which social network data are combined with e-government applications. There are many social media monitoring tools in the market, most of them related to Customer Relationship Management (CRM) in companies (Reinhold and Alt 2011; Küpper et al. 2014).

In fact, the use of social networks in government introduces new challenges and risks, which are related to data privacy, data security, and data accessibility, among other issues (Bertot et al. 2012, p. 32), especially because these platforms are operated and provided by third parties outside of government (Mergel 2015, p. 1). Ethical principles, privacy and user permission are particularly important, because of the risk of destroying the citizens' trust if power is misused. The issues need to be addressed on both the political and technological levels. Rosenberger et al. (2016), p. 1184) propose the system component "privacy manager", which filters user activities and only allows monitoring, analyzing, integrating, and storing data from users who have given their explicit permission. Another option for respecting the right to privacy is that of anonymization.

Because of trust and security issues, the use of available third-party social media tools that host their systems in the cloud and store the data in foreign countries is not desirable in the governmental context. Information about citizens in general, police records, tax returns and place of residence, for example, require high protection, especially if these data are connected to users' personal and private data in social networks. Instead of using third-party social media tools, we propose self-developing *one* integration solution that is mutually integrated with *many* social networks and leaves full control of the sensitive government data with the government. Because social networks are diverse and facilitate different user activities, there are no common social network data structures on which the integration could be built. Posts, tweets, pins, profiles, groups, and pages, which are posted, tweeted, pinned, modified, added, or viewed, constitute only a small proportion. The characteristics of the data in social networks are highly dynamic, huge in volume, unstructured, and of unknown data quality. This issue causes a challenging integration task between social networks and e-government systems.

Figure 1 illustrates the problem context and the targeted solution by contrasting two distinct integration layouts. On the left, multiple social networks (s_1-s_n) are

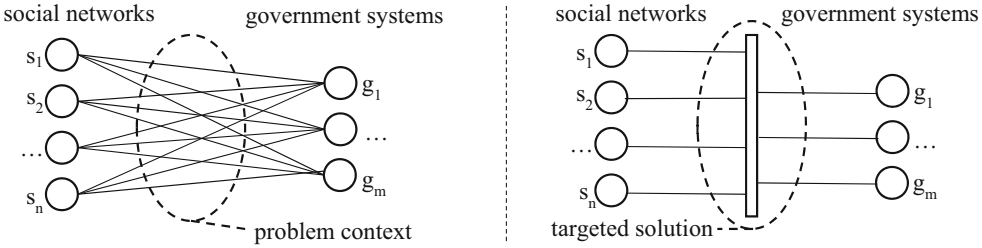

Fig. 1 Problem context and targeted solution

connected directly with multiple components of government systems (g_1-g_m). The more social networks and components that need to interact, the more complex the integration task. The number of connections is n*m. One reason for the complexity is the number of point-to-point connections. On the right, social networks are connected indirectly through a middleware (Hasselbring 2000, p. 35). Fewer connections are necessary if the numbers of social networks and government system components both exceed two. Complexity is reduced through fewer point-to-point connections (n + m), although a middleware-based approach requires common data structures.

This paper addresses the scenario on the right. The research question is: *What are the fundamental data structures of user activities in various social networks?* Our data model is developed with a design science approach. The benefits of a data model are twofold: (1) the descriptive aspect contributes to theory, because structures and concepts are visualized, and (2) practitioners can obtain specific guidance for implementing software solutions (constructive aspect).

In the following sections, we first present existing knowledge and related work on the application of social media in the public sector and user activities. We then describe the design science research methodology, after which the user activity types in social networks are described and compared with the current features of ten social networks (section 4). This conceptualization is used for the development of a data model (section 5). The final section considers the implications, limitations, and potential for further research.

2 Background

This study is linked to recent discussions about social media in government and refines existing conceptualizations of user activities.

2.1 Social networks in the public sector

A commonly mentioned goal of introducing social media in the public sector is to increase transparency and openness in government actions (Bertot et al. 2010a, p. 268). The Internet contributes considerably to this ambition, because it has reduced the costs of accessing, collecting, and distributing government information (Roberts 2006). The e-government concept takes this goal up and goes one step further, with information not only being presented online, but services being consumed electronically. In this context, web-based technologies are used increasingly to enhance service delivery (Janssen et al. 2008, p. 202). Al-Hujran et al. (2015, p. 189) note that improving transparency and accountability requires greater public engagement. Consequently, governments are extending their services and resources to "where the public is" (Bertot et al. 2012, p. 35).

Social networks are a means of involving people in government activities (Bonsón et al. 2014, p. 53), because through discussions they yield diverse insights into and perspectives from large groups of geographically dispersed users. They belong to the broader term "social media", which is "a group of Internet-based applications that build on the ideological and technological foundations of web 2.0" (Kaplan and Haenlein 2010, p. 61). These applications enable and encourage connecting, participation, collaboration, and communication between users within a social environment (Musser and O'Reilly 2007, p. 10 ff.; Porter 2010). Unlike traditional media, content is generated by users of the general public, as opposed to professionals. "Traditional media such as radio, books, and network television is primarily designed to be a broadcast platform (one-to-many), whereas social media is designed to be a dialogue (many-to-many interaction)" (Bertot et al. 2012, p. 30). Criado et al. (2013), p. 320) emphasize the collaborative, traceable, searchable, linkable and open characteristics of social networks, as core features of their use in public administrations. Social networks can be understood as "platforms to interact with citizens and organizations with innovative potentialities". The key opportunities provided by social networks in the government context are (1) democratic participation and engagement, providing a voice in discussions on policy development and implementation, (2) co-production, in which governments and the public jointly develop, design, and deliver government services to improve service quality, delivery, and responsiveness, and (3) crowdsourcing solutions and innovations (Bertot et al. 2010b).

In the study conducted by Bonsón et al. (2014), p. 56), 79 % of the examined European municipalities had an official Facebook page, but they also concede that simply having a Facebook page is insufficient. Bertot et al. (2010a), p. 298) state that a tight integration of government systems with social

media satisfies citizens' desire for open and transparent government. The authors postulate a new age of opportunity that has the potential to create IS that are open, transparent, efficient, effective and user-centered. It is important for governments to commit to taking citizens' opinions and concerns into account (Bonsón et al. 2014, p. 58). This means that social networks not be used simply as a marketing-instrument for government interests. Instead, user actions need to be integrated with e-government applications, because they are a source of insights, opinions and direct feedback from citizens (King and Cotterill 2007, p. 333; Oliveira and Welch 2013, p. 397).

The research is associated with the emerging debate subsumed under the term Big Open Linked Data (BOLD). This means that governments increasingly make their own data available to the public and seek appropriate (foreign) data sources to connect their systems, aiming at creating new or improved government-citizen applications. In this context, integrated IS are necessary, in order to make use of open data. Social networks facilitate encouraging people to use open data technologies (Janssen 2011; Zuiderwijk et al. 2015, p. 10). "Hence, integration, collaboration, and cooperation, coupled with the integration of data, information, and knowledge from different sources and organizations, could become a core area of the studies on social media in government in coming years" (Criado et al. 2013, p. 324). In particular, research oriented towards the development of specific solutions for making use of big social network data is on the increase (Chun and Luna Reyes 2012, p. 441 ff.).

Beyond the government context, companies have long recognized that integrating social networks with CRMsystems offers multiple advantages, ranging from product innovation, support-cost reduction through customers helping customers, improving a company's reputation and a better understanding of user needs and wishes (Acker et al. 2011, p. 9; Cappuccio et al. 2012, p. 430; Fliess et al. 2012, p. 81 ff.; Jahn and Kunz 2012, p. 355). The benefits for a customer are, for example, personal offerings based on the user's interests, an acceleration of support requests because of public visibility and pressure on companies to solve problems, and influencing companies' product policies and processes. Most available social media tools provide functions to monitor, filter, analyze, aggregate and visualize social media data, but only a few allow an integration with existing proprietary CRM systems (Jayachandran et al. 2005, p. 183; Reinhold and Alt 2011, p. 236; Woodcock et al. 2011; Sarner et al. 2012; Küpper et al. 2014, p. 5 ff.; Williams 2014; Trainor et al. 2014, p. 7). The (automated) integration of user activities with company data is reasonable, allowing a company to respect each user individually, instead of targeting groups only (Rosemann et al. 2012, p. 5 ff.; Valos et al. 2015, p. 731).

2.2 User activity in social media

Research on user activities in social networks is of course recent and there are a number of conceptualizations (Heinonen 2011, p. 359; Pankong et al. 2012, p. 41; Yang et al. 2013, p. 75; Richthammer et al. 2014, p. 5). These conceptualizations are valuable for understanding the user motivations to be active and show some features of social networks. However, the proposals are inappropriate for guiding the implementation of integration software between multiple social networks and government systems. For this purpose, the existing conceptualizations are too abstract or are limited in scope and not exhaustive. Especially the related data of user activities and technical accessibility has not yet been researched. Our proposed conceptualization and exploration of user activities closes this gap at least to some extent.

Atig et al. (2014, p. 850) conceive user activity as the time during which the user is active in social media. The authors classify users according to activity profiles and do not differentiate between what the users are actually doing when they are active. Heinonen (2011, p. 359) conceptualizes consumer social media activities based on two dimensions, namely consumer motivation and consumer input. Consumer motivation to use social media falls into one of three categories: information processing, entertainment activities, and social connection. The consumer input has three main types, namely consumption, participation, and contribution. The author's framework enables a classification of user activities. For example, "creating and managing a social network" is motivated by the need for social connection and requires creating a profile and linking to friends (productive consumer input). However, the proposed framework is abstract and does not enable deriving the data related to the activities. Pankong et al. (2012), p. 41) ontology for social activities is more concrete. In principle, the ontology is an entity-relationship model, which shows entities (e.g. users, posts, likes, and topics) and its relationships (e.g. "is a", "has a", and "related to"). Some entities, however, are ambiguous (e.g. reply, retweet, and comment), and the viewing of content is not included in the ontology. The model facilitates a snapshot-view of the social media graph, although the circumstances in which the users create the content is not incorporated. This is justifiable, considering that the authors focus on existing explicit and implicit relationships of users, similarly to Yang et al. (2013, p. 75). However, the location and time of an activity are also useful for determining the relevance (Yu et al. 2014, p. 32). Woerndl et al. (2011) analyze the circumstances in which user activities occur. Available sensors of a smartphone are used to surmise the current situation of

the user (e.g. installed applications, busy status, missed calls count, position from Global Positioning System (GPS) sensor, remaining battery power, and ringtone volume). Richthammer et al. (2014, p. 5) identify 11 online social network (OSN) activities. Examples are "User posts Item/Comment", "User sends messages to Contact/Page", "User is linked to Item/Comment", and "Contact/Page views User's Profile". However, these are only "fundamental user activities on OSNs" and are not complete. For example, the sharing, deletion and modification of content is not considered, so that our conceptualization generalizes and expands their work.

3 Methodology

Our research follows a design science paradigm, which is fundamental to the IS discipline, and develops new artefacts that improve the capabilities of human and organizations (Becker et al. 2008; Winter and Baskerville 2010, p. 257). Design science in IS aims at directions for action, i.e. normative and useful propositions for constructing and running IS, and innovations in IS instances themselves (Österle et al. 2010, p. 3). The results are referred to as artifacts, which can be classified into four types (March and Smith 1995, p. 253). Constructs comprise basic concepts and the symbols for describing phenomena. Models build on constructs and show their relationships and dependencies. Methods describe activities, algorithms and techniques for achieving specific goals. These artifact types can be instantiated, for instance, in the form of IS, processes, software or business models. There are many process models which can guide a design-science-oriented research project (Archer 1984; Takeda et al. 1990; Eekels and Roozenburg 1991; Nunamaker and Chen 1991; Walls et al. 1992; Rossi and Sein 2003; Hevner et al. 2004; Peffers et al. 2006). Basically, what these approaches have in common is that they propose phases for identifying the problem, development, evaluation and communication of the artifact. Peffers et al. (2006, p. 93) proposes six activities, which are (1) problem identification and motivation, (2) defining the objectives for a solution, (3) design and development, (4) demonstration, (5) evaluation, and (6) communication. The data model of user activities in social networks has been developed from a deductive-inductive approach and can be classified as an objective-centered solution (Peffers et al. 2007). The preliminary results were demonstrated and communicated at the 14th IFIP Conference on e-Business, e-Services and e-Society (I3E 2015). One participant suggestion was to extend the scope of the results towards social media in government, focusing on integration.

The literature review follows vom Brocke et al.'s (2009) methodology, which comprises three process steps, being (1) definition of review scope, (2) conceptualization of topic, and (3) literature search. The authors highlight that not only the results should be presented, but also, in order to allow replicability, also details about the approach. The scope (1) of the literature review is characterized by six aspects from Cooper (1988) (Table 1). We did not limit our search to specific social networks for achieving a higher generalization.

The focus (a) is on existing research results concerning user activities in social media or social networks respectively. The goal (b) is to connect to existing knowledge on a conceptual level (c). The perspective (d) can be characterized as neutral representation, because the position is unbiased. Practitioners and researchers of social media in government are the target audience (e). The results are representative (f) for the IS community, because prominent data sources have been used and queried.

The conceptualization of the topic (2) includes a "working definition of [the] key variable(s)" (Webster and Watson 2002, p. 15). Relevant terms are social media, social network, user actions, and user activities. A keyword search (3) in the databases of AISel, EBSCO, Emerald, IEEE, JSTOR, ProQuest, and Web of Science in the title (TI), topic (TO), abstract (AB), keyword (KW), and full text (TX) fields was applied, using the search string: *("social media" OR "social network") AND ("user actions" OR "user activities")*. The initial list of publications was filtered by reading the titles and abstracts, and relevant papers were analyzed from the full texts. Table 2 shows the numerical results of the keyword searches.

The development of user activity types comprised a study of features from large, popular social networks. The sample of sites for analysis was selected from the following criteria: (1) large number of active users per month (> 100 m.); (2) English localization of the platform; and (3) availability of a public API. The initial list of contemplable sites was compiled of studies and rankings of social networks (Singh et al. 2012, p. 694; Criado et al. 2013, p. 320; Statista 2014). The listed sites were evaluated against the aforementioned criteria, based on information from press releases, technical notes, terms of use, and responses from enquiries to the providers. The final list included Facebook, Flickr, Google+, LinkedIn, Meetup, Pinterest, Tumblr, Twitter, Xing, and YouTube. Possible user activities were gathered by analyzing the features and functions, and were grouped according to the philosophical notion of family resemblance, and following an abstraction-based modelling approach (Rosch and Mervis 1975, p. 575; Bussler 2003). For example, reply, retweet, and comment share a similar structure and function and have been grouped into a single object type.

Table 1 Literature review taxonomy (from Cooper (1988))

Characteristic	Categories			
(a) focus	research outcomes	research methods	theories	applications
(b) goal	integration	criticism	central issues	
(c) organization	historical	conceptual	methodological	
(d) perspective	neutral representation	espousal of position		
(e) audience	specialized scholars	general scholars	practitioners	general public
(f) coverage	exhaustive	exhaustive and selective	representative	central/pivotal

Criado et al. (2013), p. 321) conclude that current studies in the context of e-government and social media have generally applied quantitative, qualitative, and mixed method approaches and coincidently state that "the study of social media in government may demand specific methodological approaches that differ from those used in previous studies of e-government."

4 User activity in social networks

Graph theory is applicable to the structure of the web in general and to social networks in particular (Smith et al. 2009). This means that the entities in social networks constitute nodes in a graph. Social network data could be made available to government applications by replicating the respective graphs in the respective systems. However, the graph sizes are immense with billions of nodes, and even more connections among them. Moreover, a full copy of multiple social network graphs is neither practical, due to storage requirements and access restrictions of providers, nor is it reasonable in terms of efficiency. Thus, only a subset of social network data is relevant. One option is to start with a node of interest and to perform graph traversal, thus resolving the connections that lead to further entities. For example, the starting point could be a citizen's profile or an individual post, which is connected to friends, "likers", and comments. The number of connections to be followed can be determined and restricted, so as to meet the limitations of storage space and processing time. Relevant developments, however, which occur in parts of social networks that are not included in the traversal, will be omitted. Moreover, the paths from the starting point to relevant social network entities may lead via nodes that are irrelevant. There is no way to know in advance all the useful paths and thus, a compromise between efficiency and completeness must be made.

Table 2 Numerical results of the keyword searches

Data source	Search fields	Publications	
		Total	Relevant
AISeL	TI, AB	11	2
EBSCO	TI, AB, KW, TX	22	5
Emerald	TI, AB, KW	30	1
IEEE	TI, AB, KW	4	1
JSTOR	TI, AB, KW, TX	9	1
ProQuest	TI, AB, KW	4	1
Web of Science	TI, TO	4	1
Total			10

The total number is not equal to the column sum, because duplicates have been counted only once

In contrast, the proposed user activity types in social networks follow a different concept by addressing changes in the graph. Creating and deleting vertices and edges are the basic operations of such a graph (Gross and Yellen 2004). Because social network data can be depicted graphically and is user-generated, *changes in the graph represent user activities*.

The user activity types shown in Fig. 2 represent the actions that users perform in social networks. Activities take place in the context in which the user is situated, defined by time, location, social network site, device and application. The combination of an object type and an action is termed a user activity type in social networks. The complex graph structure of social networks is broken down into an activity log, which contains entries of the form: user u invoked action a on object o (on site s with device d in application p from location l at time t).

Five actions can be applied to eight object types. All user-generated content results from the Create-, Update-, or Share-action. The content is displayed on the screens of the user devices via the View-action, whereas the Delete-action removes content. The variety of features across different social networks that facilitate the creation, modification and viewing

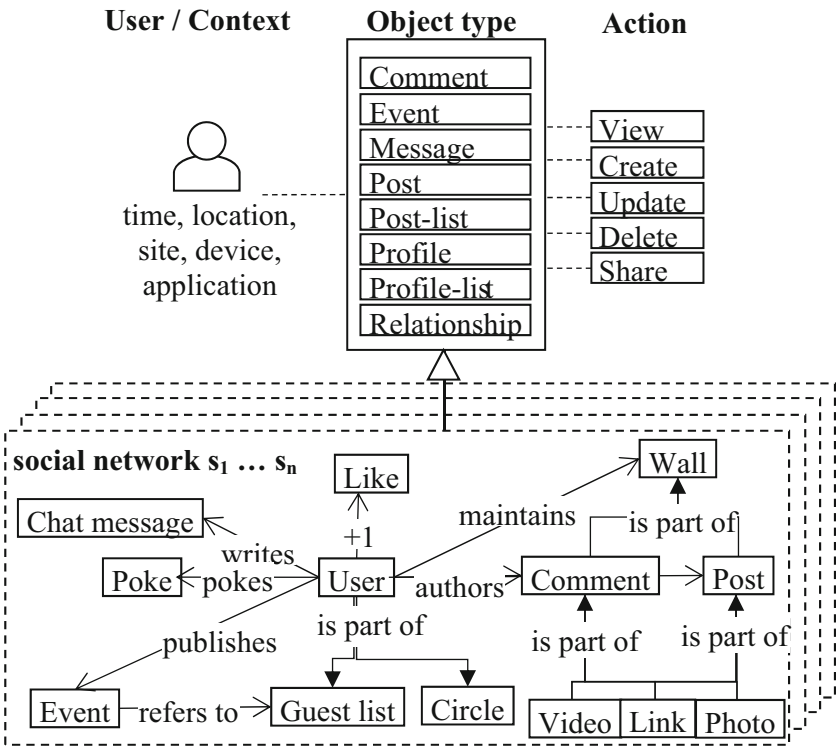

Fig. 2 User activity types in social networks (Rosenberger et al. 2015)

of content is reducible to 8 × 5 user activity types. On an aggregated level, the key activities that users can perform in various social networks are structurally equal.

4.1 Object types in social networks

The idea of family resemblance is used to group similar objects. The most prototypical objects constitute an object type. An object type subsumes all objects which have most functions and structures in common with that object type, and have the least commonalities with other object types (Rosch and Mervis 1975).

Kietzmann et al. (2011, p. 243) present a framework of functional building block for social media, which comprise identity, conversations, sharing, presence, relationships, reputation, and groups. The seven blocks are facets of user experience in social networks and provide an orientation for gathering object types and functions.

Table 3 identifies object types by analyzing structures and functions (Faulkner and Runde 2013, p. 807).

An object type enables a function if it supports the intention behind the concept of the building block. It is partly enabling if the intended user experience of the functional building block is merely a side-effect. An object type does not contribute to a functional building block if it does not enable the function at all.

The eight object types may have variants that share similar concepts, but have a different terminology or are used to distinguish the same *concept* used in different *contexts* on the same site. An example is a Comment, which contains multimedia content and has a parent, which may be a Post, Post-list, Comment or another object type. Some sites use a Comment object type to represent answers, like Tumblr, or a job application like Xing.

The same object type is also used in different variants on the same social network, such as on Facebook, where there are both comments and reviews. A Comment contributes primarily to the functional building block of Conversations and Sharing.

An Event object type defines a happening, which is related to time. It can be a birthday party, a music festival, a meeting, and so on. Events facilitate meeting people (Presence), build communities (Groups), and relate to each other (Relationships). A Message is multimedia content that is addressed to a specified set of receivers. Posts subsume a main content entry found on all social networks. They may be termed tweet, job, or pin, and facilitate interaction by allowing Comments and Relationships to be added. A Post-list is a collection of Posts. A Profile is a representation of a real life entity, such as a person, public organization, company, or community. A Profile-list is a collection of Profiles with possible variants, such as a circle, contact list, or friend list. A Relationship connects two other objects. An example is a bookmark, which can be described as a Relationship between a Profile and a Post. The poke feature in Facebook can be treated as a Relationship between two Profiles.

Table 3 Technical identity of social media objects (Rosenberger et al. 2015, p. 113)

Object types	Structure / data	Functions						
		Identity	Conversations	Sharing	Presence	Relationships	Reputation	Groups
Comment	- contains content (e.g. text, video, audio and image) - refers to another object	○	●	●	◐	○	◐	○
Event	- contains descriptive information about a particular happening - is related to time	○	○	○	●	●	◐	●
Message	- contains content (e.g. text, video, audio and image) - has a sender and recipient (list)	○	●	●	◐	○	○	○
Post	- contains content (e.g. text, video, audio and image)	○	●	●	◐	○	◐	○
Post-list	- is a collection of posts	○	●	●	◐	◐	○	◐
Profile	- contains descriptive information about an actor	●	○	◐	●	◐	●	○
Profile-list	- is a collection of profiles	◐	◐	○	◐	●	●	●
Relationship	- connects two objects	○	◐	○	◐	●	●	◐

Object type…(○) does not enable the function, (◐) partly enables the function, (●) enables the function

4.2 Actions on social network objects

Table 4 lists actions, which can be invoked on social network objects referring to Hypertext Transfer Protocol (HTTP) methods. HTTP is the underlying, technological protocol of social networks (Gourley et al. 2002). Five basic actions on social network objects can be identified. Sharing is something found particularly in social media (Kietzmann et al. 2011, p. 245). The citing of a text phrase or the re-tweet of content on Twitter is an example of the Share-action.

4.3 Accessibility of user activities in social networks

The APIs of large social networks define access options for functions and data using web-services. They include formats and provide methods for publishing posts, resolving connections between users, and retrieving comments, for example. On the other hand, it cannot be ruled out that access is included in upcoming versions. Furthermore, using the APIs is not the only access approach to social network data. Instead of using the API, the View-action of

Table 4 Actions on social network objects (Rosenberger et al. 2015, p. 114)

Action	Description	HTTP Methods
View	View is triggered when content of an object is loaded and displayed on the user's screen (e.g.: a video is played).	GET
Create	The Create-action occurs when something new is added, as opposed to the Update-action when a change to an existing object is done by a user.	POST
Update	The Update-action results in a modified, existing social media object.	PUT/MOVE
Delete	When an object is removed on social media, an event with the action Delete is raised.	DELETE
Share	The Share-action occurs when existing content, usually originating from another user, is put into a different context or is exposed to additional users on the same platform. It is a copy of an existing entity.	COPY

one's own and shared posts can be recognized by linking a Facebook post with external content from a government website, where the public organization can evaluate page requests (by observing the HTTP/1.1 GET-method).

Six user activity types are theoretical constructs, which do not occur in the analyzed social networks. These are Message/Update, Message/Delete, Message/Share, Profile-list/Share, Relationship/Update, and Relationship/Share. Firstly, a Message is private, because it cannot be shared. Secondly, a Message, once sent, cannot be retrieved, removed, or edited. A Profile-list cannot be shared by others. Access privileges to the Profile-lists are maintained by the owners only. A Relationship either does exist or does not exist. It cannot be modified, but it can be deleted.

Table 5 shows the results of the empirical exploration of user activities in ten social media. Dark underlined numbers signify that the user activity type can be monitored in the specified social network using the provided API. Dark numbers that are not underlined mean that the type exists on the site, but the APIs of the site do not provide access to monitor it. For example, in Facebook, a user can view a post. However, this activity cannot be monitored using the public API of Facebook in the recent version of the Graph API V2.1 (Facebook 2015).

On the other hand, it cannot be ruled out that access is included in upcoming versions. Furthermore, using the APIs is not the only access approach to social network data. Instead of using the API, the View-action of one's own and shared posts can be recognized by linking a Facebook post with external content from a government website, where the public organization can evaluate page requests (by observing the HTTP/1.1 GET-method).

Six user activity types are theoretical constructs, which do not occur in the analyzed social networks. These are Message/Update, Message/Delete, Message/Share, Profile-list/Share, Relationship/Update, and Relationship/Share. Firstly, a Message is private, because it cannot be shared. Secondly, a Message, once sent, cannot be retrieved, removed, or edited. A Profile-list cannot be shared by others. Access privileges of the Profile-lists are maintained by the owners only. A Relationship either does exist or does not exist. It cannot be modified, but it can be deleted.

The majority (70 %) of user activity types that exist in a social network, can also be monitored using the API and can thus be integrated into government systems using a public, recommended access approach. The View-actions are usually not provided; only Google + has custom activities which can be triggered by developers if an entity is read.

On most social networks, Post/Create is observable by subscription to Post-lists. The Update-, and Delete-actions can be identified by periodic polling, whereby known objects are checked regularly in order to observe if they are still existent or modified. Comment, Post, Profile, and Relationship exist in all analyzed social networks. Thus, these are essential object types. Facebook (83 %), Google + (80 %), and Xing (80 %) feature the most complete set of user activity types. The APIs of Google+, LinkedIn, and YouTube provide the most complete set of access options, covering 95 %, 80 %, and 79 % of applicable user activities of each site.

4.4 Data model of user activities in social networks

The proposed user activity types in social networks must be further concretized to guide the implementation of a software solution. Figure 3 shows the object-oriented data model of user activities derived from the user activity types. The notation follows the recommendations for class diagrams in Unified Modeling Language (UML). The central object type is *Social Media Activity*, which is basically associated with *Object Type*, *Action Type* and an *Actor*. A user's context is described by attributes of *Social Media Activity* (e.g. *Start Time* and *End Time*) and attributes of *User* (e.g. *Time Zone* and *Location*). *Social Media Object* is an abstract object type which is specialized by *Message*, *Event*, *Profile-list*, *Profile*, *Post-list*, *Post*, *Relationship* and *Comment*. The common quantity are *Name*, *Creation Time*, *Modification Time*, and a variable number of *Statistical Numbers*. These are aggregated numbers, like "count of views", "count of comment", "average duration of visits", that are often made available explicitly by social network providers (Facebook 2015). Profiles in social networks are specialized by *User* and *Organization*. Object types are related to each other (association and aggregation). For example, an object of type *Post-list* is composed of a various number of instances of *Post*. *Message* is associated with *Sender* and one or multiple *Recipients* of type *User*. The object types *Event, User, Organization* and *Post-list* have the attribute *Description* of type *Field Entry [*]*. The variable number of *Field Entry* makes multiple describing data fields possible, which consist of a platform-independent name, a platform-specific name, and a variable number of values. An example is the describing data field for User with the platform-independent name "Religion", which can be freely assigned, the platform-specific name "religion", which is given by Facebook and the values "Christian", "Muslim", "Hindu", "Buddhist" etc. The specific data of a user activity, whereby a user adds a new photo to a photo-album, are the name of the photo-album, the creation time and location of the user activity and the time the photo was taken, dimensions and size of the photo, as well as marked persons. The structure of the data is independent of the social network in which the user activity occurs.

Table 5. Empirical exploration of user activities in social media (Rosenberger et al. 2015, p. 115)

Action / Object type	View	Create	Update	Delete	Share
Comment Answer, Recommendation, Job Application, Review	❶❷❸❹❺ ❻❼❽❾❿	❶❷❸❹❺ ❻❼❽❾❿	❶②❸④❺ ⑥⑦⑧❾❿	❶②❸❹❺ ❻❼❽❾❿	❶②③④⑤ ⑥❼❽❾⑩
Event Meeting, Happening	❶②❸④❺ ⑥⑦⑧❾⑩	❶②③④❺ ⑥⑦⑧❾⑩	❶②❸④❺ ⑥⑦⑧❾⑩	❶②❸④❺ ⑥⑦⑧❾⑩	❶②❸④⑤ ⑥⑦⑧❾⑩
Message Chat, Fanpost, Gift	❶❷❸❹❺ ⑥❼❽❾⑩	❶❷❸❹❺ ⑥❼❽❾⑩	①②③④⑤ ⑥⑦⑧⑨⑩	①②③④⑤ ⑥⑦⑧⑨⑩	①②③④⑤ ⑥⑦⑧⑨⑩
Post Job, Life event, Pin, Project, Question, Status, Tweet	❶❷❸❹❺ ❻❼❽❾⑩	❶❷❸❹❺ ❻❼❽❾⑩	❶②❸④❺ ❻❼⑧❾⑩	❶❷❸❹❺ ❻❼❽❾⑩	❶②❸❹⑤ ❻❼❽❾⑩
Post-list Blog, Board, Page, Photo album, Wall	❶❷❸❹❺ ❻❼⑧❾⑩	❶❷❸❹❺ ❻❼⑧❾⑩	❶❷❸❹❺ ❻❼⑧❾⑩	❶❷❸❹❺ ❻❼⑧❾⑩	❶②❸④⑤ ⑥⑦⑧❾⑩
Profile Community, Company, Public Organization, User	❶❷❸❹❺ ❻❼❽❾⑩	❶❷❸❹❺ ❻❼❽❾⑩	❶❷❸❹❺ ❻❼❽❾⑩	❶❷❸❹❺ ❻❼❽❾⑩	①②③④⑤ ⑥⑦⑧❾⑩
Profile-list Circle, Contact list, Friend list, Group, Guest list, Partner list	❶❷❸❹❺ ⑥⑦❽❾⑩	❶❷❸❹❺ ⑥⑦❽⑨⑩	❶②❸❹❺ ⑥⑦❽❾⑩	❶②❸❹❺ ⑥⑦❽⑨⑩	①②③④⑤ ⑥⑦⑧⑨⑩
Relationship Bookmark, Favourite, Follow, Invitation, Join, Like, Poke, Rating	❶❷❸❹❺ ❻❼❽❾⑩	❶❷❸❹❺ ❻❼❽❾⑩	①②③④⑤ ⑥⑦⑧⑨⑩	❶❷❸❹❺ ❻❼❽❾⑩	①②③④⑤ ⑥⑦⑧⑨⑩

1-Facebook, 2-Flickr, 3-Google+, 4-LinkedIn, 5-Meetup, 6-Pinterest, 7-Tumblr, 8-Twitter, 9-Xing, 10-YouTube

Event type (◯) does not exist on the social network, (●) exists on the social network, (●) exists on the social network and can be accessed using the API

5 Contributions to theory and implications for practice

The aim of this study was to promote government innovation by enabling new or better citizen services through the integration with user activities of social networks. From a research perspective, the contribution of our study is threefold. Firstly, this is the first paper to develop a comprehensive conceptualization of user activities in social networks and, building on this, a data model combining both a theoretical foundation and an empirical exploration. We use an abstraction-based modeling approach for conceptualizing the common fundamental data structure of ten prominent social networks, which result in 40 user activity types. We follow Bertot et al. (2012), p. 36) call for more research that focusses on making use of citizen feedback in social media. Secondly, the concept is not limited to governments, but is also applicable to the business sector, where companies wish to enhance the management of customer relationships.

Thirdly, we join the debate on defining user activities, which are understood in various ways in research. Some authors define activity profiles according to active user time (Atig et al. 2014, p. 850), describe different user motives to be active (Heinonen 2011, p. 359) or examine the context of user activities (Woerndl et al. 2011; Yu et al. 2014, p. 32). Our proposed user activity types specify what users do when they create or consume content. Hence, the user activity types advance from existing understandings of user activities and progress to characterize the contained data. A user activity type is a crossover of an object type and an action and takes place in a specific user context. The object types reveal the underlying structure and data which large social networks share. The actions are operations that users perform with an

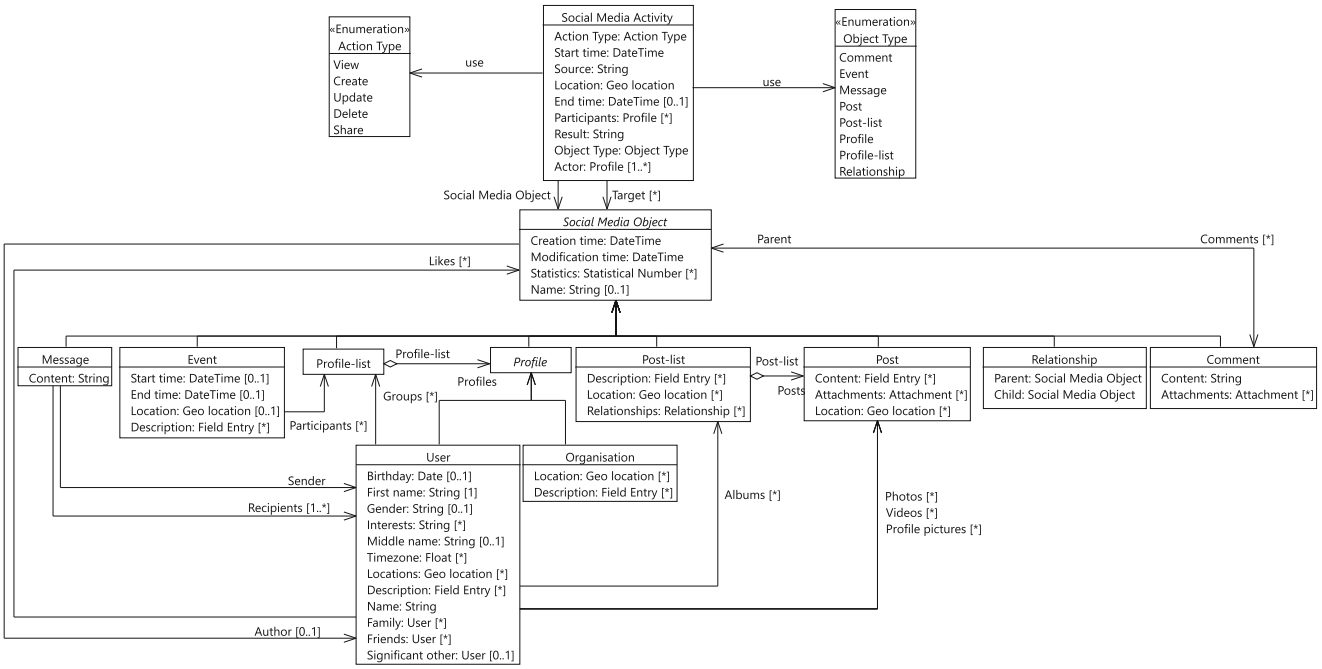

Fig. 3 Data model of user activities in social networks

object type. The user-context describes the situation in which the user resides while invoking an action on an object.

For practitioners, our results can assist governments in developing a solution that mutually integrates multiple social networks and refrains from individual APIs by wrapping specific calls. Instead of using third-party social media tools, we plead for self-developing an integration software so that the government retains full control of the sensitive government data that is linked to social network user data. The data model supports this initiative in terms of a blueprint. The intended middleware-based solution requires similar information structuring. The presented user activity types support this purpose, because they allow for consolidating the different user activities of different, large social networks.

6 Limitations and future research

The user activity types in this research originate from the abstraction of individual features collected from a study of ten social networks. They have an empirical basis and rely on publicly available data. The issue, caused by the underlying induction of the abstraction, is that the user activity types are only clearly valid for the analyzed social networks, and are not necessarily generalizable to all available sites. Changes to the social networks' features may necessitate modifications of the data model, so that the "future-proofness" and robustness against various changes needs to be studied further.

The conceptualization of user activities was originally developed with a focus on Customer Relationship Management (CRM) in companies. We argue that the results are also applicable to the integration problem between social networks and e-government systems. The application of CRM-concepts to this context is not new, but requires a dedicated analysis (Kannabiran et al. 2005; King 2007; Reddik 2010), particularly because of the different organizational goals of different companies, which are profit-oriented, and governments which aim to provide reliable and efficient services for citizens and companies. However, for understanding the types of user activities and the related data structures in social networks, new/different artifacts are not needed.

Monitoring user activities in social networks leads to a reactive system (Sarkar et al. 1995, p. 1). A fully integrated IS, however, should comprise functions to interact, requiring both directions of communication. This is not contrary to the research results, but constitutes a possible extension. The general practicability of the research results for the development of real integration solutions still needs to be evaluated. The integration of social networks in government activities also requires a change in how governments operate (Mergel 2015, p. 5), i.e. citizen participation in policy-making processes, whereby citizens are encouraged to discuss ideas and plans. Certainly, an (automated) integration solution leads to new challenges, like duplicate detection, the definition of filtering rules and selection of relevant data. There are technical restrictions limiting the feasibility of capturing "everything", because some user activity types cannot be captured using the APIs. Moreover, as also highlighted by other authors, user permission and privacy need to be considered (Woodcock et al. 2011, p. 256), constitutes be a major concern for all social media initiatives in government. Not only because of the risk of destroying citizen trust in case of an accident (e.g.

unintended data exposure to unauthorized parties), but also from an ethical and political perspective considering personal will, the right to privacy and "right to be forgotten". In the era of progressing digitalization of the whole economy, the "totally transparent citizen" is a high and serious risk. As a result, not every user activity that can be captured technically should also be tracked, analyzed and stored. Governments should obtain user permission first and let the users register for the enhanced public service (opt-in instead of opt-out). In the registration process, the users decide what kinds of activities are assessed. When integrating user activities, it should be noted that the truth/validity of the data in social networks (e.g. profiles and posts) must be scrutinized, because the data quality has not been verified.

Further research is planned to define methods to analyze user activity data for solving complex tasks (e.g. identification of the sentiment of posts and selection of all activities of users of a specific social group, based on age, interests, work place and place of residence). Depending of the social network and the user permission settings, only some data are available (Mohan et al. 2008, p. 239). Some social networks sell the usage of their APIs, while other providers offer a maximum number of requests per month and thereby restrict the use. This reasserts that governments should not depend on single social networks, but should mutually integrate multiple social networks. Varying legal conditions concerning the protection of personal data and privacy exist in different countries and must be respected (van der Aalst et al. 2005, p. 556).

A standardization of the APIs of different social networks is desirable from a software developer perspective, because the need to convert proprietary data structures into a common format would then become obsolete. Some work in this direction has already begun (W3C Social Web Working Group 2015), but it is uncertain whether the large social network providers will follow these proposals.

Instead of integrating foreign social networks, building one's own social network, which is run and maintained by the government, is another option. This would provide better control and remove the dependency on third-party providers. However, establishing a sustainable community that is well adopted by its users is not a trivial task and depends on user motivation to participate and contribute (Spagnoletti and Resca 2012, p. 4083). A government-run social network also requires integration with existing e-government systems, in order for the results of this study are applicable.

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Marcel Rosenberger holds a master’s degree with honors in information systems from the University of Duisburg-Essen, Germany, and received a Ph.D. in management from the University of St.Gallen, Switzerland. He earned various certificates in the fields of IT service management, Enterprise Architecture, Business Process Management, and service-oriented architecture. He is founder and Managing Director of a consulting firm specialized in planning and management of business and IT-resources. Since 2006 he has run more than 25 projects in government authorities and companies of various industries in Europe and Asia. His fields of interest include business-IT alignment, systems integration and software project management.

Dr. Christiane Lehrer is postdoctoral researcher at the Institute of Information Management at the University of St.Gallen (HSG), Switzerland. She earned her Ph.D. in Business Administration and a Master in Communication Studies from LMU Munich, Germany. Her research involves the impact and potential of digital consumer interaction, as well as the impact of business intelligence and analytics on organizations. Lehrer has published her research in journals such as the European Journal of Information Systems, and Electronic Markets, as well as in the proceedings of national and international conferences, including the International Conference on Information Systems, and the European Conference on Information Systems.

Reinhard Jung holds a master degree in business administration (University of Dortmund, Germany) and received a Ph.D. in business informatics from the University of Muenster (Germany) in 1998. From 1997 to 2001 he worked as a project manager and senior lecturer at the University of St.Gallen, Switzerland. From 2002 to 2006 he was assistant professor at the University of Bern where he received the Credit Suisse Award for Best Teaching. In 2007 he was appointed full professor of information management at the University of Duisburg-Essen (Germany). He heads a consulting company in St. Gallen and is currently a full professor of business engineering and academic director of the Executive MBA in Business Engineering and various other executive programs at the Institute of Information Management at the University of St.Gallen (HSG). His research focuses on digital transformation, business engineering, social CRM and data management.