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Social Computing: a Classification of Existing Paradigms

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***Abstract*—In less than three decades, several paradigms of social computing have emerged. Among them, groupware, social software and mobile social software (MoSoSo) are the most widely known. Although all significant, it is challenging to recognize the function and unique features of each single paradigm. This situation represents an obstacle for a coherent development of social computing, a research domain that is highly fragmented and with relevant literature spread across several disciplines. In this paper, a classification of existing social computing paradigms is introduced as an initial effort to combine the lines of discourse concerning social computing.**

Keywords-component; social computing, social software, groupware, mobile social software, MoSoSo, classification

I. INTRODUCTION

The potential of networked computers as communication devices was understood already in the Sixties [1], but their social significance for everyday life has only emerged during the last two decades. Indeed, the mid-Nineties have been described as the period of transition from personal to social computing [2]. Unlike personal computing, which focuses on the individual use of information and communication technologies (ICT), social computing deals with the collaborative use of ICT by small social groups or larger communities of users.

It has been argued that social computing applications have profound consequences on society and the economy [3]. Although there is no doubt of this fact, it is extremely difficult to compare studies on the topic and to quantify its real impact; this is due to the inorganic growth of social computing as an inherently interdisciplinary, but highly fragmented research field. Quite surprisingly, little efforts have been put forward until now to put together the multiple traditions that contributed to social computing [4, 5, 6]. The lack of a common language used by the research communities involved in social computing may prevent them from obtaining breakthroughs that require an interdisciplinary approach. Without a clear demarcation of the scope and its functional relationship with the other paradigms, social computing is likely to remain a domain with relevant knowledge spread across disciplines. There is a strong need of a shared language based on a commonly agreed and understood terminology. Without it, a constructive exchange and development of ideas and experiences, even between scholars and practitioners of closely related research fields, may be unsuccessful.

The aim of this paper is to illustrate that an organic growth of social computing research cannot take place because of the vague conceptualization of its underlying paradigms. A first step towards the solution of this problem consists in the introduction of a simple classification of the three main social computing paradigms, namely groupware, social software and mobile social software (MoSoSo). In the long term, the desired outcome would be to obtain a joint research agenda for social computing. This would allow overcoming its current fragmentation, better addressing its key research problems in an interdisciplinary manner and enhancing the usefulness and productivity of academic and industrial investments in this area.

In the following section, the historical roots of social computing are described. Then, related work on social computing classifications is introduced. This insight is used to derive a simple classification of the three main social computing paradigms. Finally, the significance of the classification is presented, discussing potential applications and pointing out issues to be addressed in future research.

II. TRACING THE HISTORY OF SOCIAL COMPUTING

The origins of social computing are linked to the tradition of research on human-computer interaction (HCI). In one of its first appearances in scientific publications, social computing was described by Schuler as "*any type of computing application in which software serves as an intermediary or a focus for a social relation*" [7]. Using similar terms, Dryer, Eisbach and Ark presented social computing as a theoretical concept involving both science and technology, referring to "*the interplay between persons' social behaviors and their interactions with computing technologies*" [8]. More recently, social computing has been defined as the "*computational facilitation of social studies and human social dynamics as well as the design and use of ICT technologies that consider social context*" [9].

Although different in wording and focus, all these definitions place social computing between computer science and the social sciences, thus underlining the interdisciplinary nature of the research area. Hence, the study of social computing and development of social

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applications needs to embed concepts such as community, social networks, social relationships and social action. On the other hand, data gathered through social computing applications does not only help to facilitate social interactions, but also to better understand and computationally model the social world, from the small-scale level of dyadic interactions to the large-scale level of interconnected and evolving societies. From this viewpoint, software designed to visualize online social networks [10] or to sense complex social systems [11] inherently belongs to the social computing ecosystem.

Encompassing the whole spectrum of the social world and all possible types of computing machinery, social computing can be therefore regarded as a general umbrella term including several paradigms. The most well-known and widely studied is groupware; this paradigm was originally defined by Johnson-Lenz and Johnson-Lenz as "*intentional group processes plus software to support them*" [12]. It must be noted that groupware, the prototypical paradigm of social computing, was introduced in the Eighties, several years before social computing was conceived. Back then, the scope of groupware was mostly limited to small-group social interactions taking place in academic environments or organizations, which were the typical contexts of computer-mediated communication (CMC). Consequently, the goal of groupware was to support team productivity and collaboration. Research on these issues led to two main strands of research, namely computer-supported cooperative work (CSCW) [13, 14] and computer-supported collaborative learning (CSCL) [15].

As the scope of CMC broadened, in the Nineties scholars investigated the potential of software for creating and developing physically-based local communities, or community networks [16, 17, 18, 19], and virtual communities, forms of human association existing only in cyberspace [20]. Along with these emerging frontiers of research, also new terms were coined: for Ishida [21], groupware was not suitable to describe community interactions; therefore, he introduced communityware to extend groupware beyond the small group and formal interaction. Despite the good intentions, communityware did not reach the same popularity of groupware and remained a marginal phenomenon. A related paradigm, socialware, was presented as "*multiagent systems to assist in various social activities on network communities*" [22], but did not have better luck than communityware.

With the turn of the millennium, the rapidly evolving Internet led to the emergence of a new concept, social software, which was loosely associated to all forms of Web-based social communication. Contrarily to groupware, which was coined within the context of academic research, social software was presented to a more business-oriented public at the Social Software summit in 2002. As boyd observed, "*the event was invite-only and the participants were primarily invested in the development of new genres of technologies. While research and development in social technology extends back decades, none of the old guard was present*" [6]. The intentional creation of a gap with the existing groupware community has certainly contributed to the fragmentation of social computing. The goal of the Social Software summit seemed to be more to take distance from the past than to really launch a new technology: indeed, Shirky's original definition of social software as "*software that supports group interaction*" [23] does not differ much from the definition of groupware. To the emerging social software community, groupware was no longer suitable for keeping up with technological advances and for addressing their extended social scope. In short, groupware was regarded just as an old-fashioned paradigm to be replaced with a more powerful and evocative concept. The fact that it was not dissimilar in meaning was of secondary importance. This choice divided academics and practitioners, who developed two overlapping and disconnected domains of knowledge.

Despite the claim of being 'old-fashioned', the groupware community is still active and has expanded the scope of its research to mobile and ubiquitous contexts [24, 25, 26, 27]. In the introduction of the special issue of the International Journal of Human-Computer Studies, De Vreede and Guerrero stated that "*research in groupware is thriving like never before*" [27]. On the contrary, social software has struggled to find its stable position in the social computing terminology; this is partly due to the consensus gained by a new related paradigm, social media, which appeared around 2005 in parallel with the emergence of the Web 2.0 [28]. By replacing the term 'software' with 'media', the goal was to shift from a technological to a more human-oriented view of social computing interactions; this view emphasizes the dynamics and impact of social practices such as the co-creation, sharing, tagging, and commenting of digital media [28, 29]. Following this approach, social computing was linked to "*Internet 2 based technologies*" [30] such as blogs, podcasts, wikis, social networking sites and peer-to-peer services, which are driven by spontaneous interactions among users in the production, distribution and consumption of digital content and services.

Another situation contributed to fragment the social computing landscape even further. When social software was introduced, digital interactions were becoming increasingly wireless and mobile. It seemed therefore natural for Melinger [31] to emphasize the importance and implications of MoSoSo, social software designed for interactions in mobile contexts. As a new trend, MoSoSo gained momentum between 2005 and 2006, when it appeared in several scientific publications [11, 32, 33, 34] and in a dedicated workshop at the annual conference on Human Factors in Computing Systems (CHI) [35]. Research on MoSoSo peaked in the following years [36, 37, 38, 39, 40, 41, 42], but similarly to social software it had to face the emergence of mobile social media [43, 44, 45, 46].

Although a short remark on the differences between software-oriented and media-oriented definitions of social computing paradigms has been illustrated, a detailed analysis is out of the scope of this paper. For this reason, social software and social media, as well as MoSoSo and mobile social media, are treated here as synonyms.

III. On Social Computing Classifications: Related Work

Much research on all the three main paradigms of social computing is available, but almost no effort has been put forward to clearly conceptualize social computing paradigms [4, 5, 6] and to understand what differentiates groupware from social software and MoSoSo.

A conceptualization of social computing dimensions was derived by a study on the use of social computing in organizations [47]. By adopting a multidimensional scaling methodology, 13 types of social computing applications were analyzed and three basic dimensions discovered: the ability to support group and community interactions and relationships; the hedonist or utilitarian focus; the distinction between convergence and conveyance of user-generated content. Although classic literature on social computing is mentioned [7, 8], the authors regard such studies as obsolete because in this view social computing is part of the Web 2.0 [28]. This link is also common in other studies on social computing [3, 30]. Even if such approach is conceptually straightforward and easily applicable in practice, it does not contribute to integrate the existing research on groupware and social software into a single discourse.

By recognizing that the existing definitions of social software are mostly techno-centric, Bouman and Hoogenboom [5] argued that an appropriate definition should take into account the way social software is embedded in socio-cultural practices. Indeed, recent attempts in defining the building blocks of social media [4] are adopting a more social than technological perspective. Using a similar approach, boyd [6] evaluated the significance of social software by illustrating its relationship with groupware. According to the author, one of the reasons for the 'incompatibility' between groupware and social software can be found in the different values, scope and purpose of the communities that created and developed those concepts: on the one hand, the academic community contributed to groupware research, and on the other the business-oriented communities coined and adopted the notion of social software. This implies that the two paradigms differ in their wider meanings: while groupware refers to a set of collaborative technologies, social software represents a movement promoting a new generation of online applications, the Web 2.0 [28], which was born as a solution to the failure of the Internet bubble at the end of the Nineties. This period therefore marks the transition from groupware to social software, which introduced three new features compared to its predecessor.

First, social software is designed differently from groupware. While groupware employed the traditional methods and processes of software engineering, social software introduced a less linear model of product development based on the principles of co-creation and co-development between users and company system designers. One of the most important consequences of this novelty concerns the speed of the innovation process, which is significantly faster for social software. As users voluntarily fix bugs and invite friends to connect, the costs for improving the application and for reaching critical mass are significantly lower than for traditional groupware systems.

A second characteristic of social software is that its value for users is directly proportional to the value that social networks have for them. The best example is provided by social networking sites (SNS), which are practically useless if a user does not invite contacts to connect. Furthermore, social software is also strongly characterized by the culture and norms of its communities, making some SNS more appealing to teenagers (e.g. NetLog) and some others to musicians (e.g. MySpace) or academics (e.g. Mendeley).

A third important feature is related to the contexts in which social software is used. Social software has typically no predefined topics, goals, or interests; rather, these emerge spontaneously with the interaction of networked users. Groupware applications are traditionally designed to meet the needs and profiles of the collective group (e.g. a school class, work colleagues), while social software typically provides an egocentric view of one's social world [4]. In other words, groupware and social software are designed for two different social units, namely the collective group and the networked individual.

boyd's intention was to clarify the history and relationships between groupware and social software. Her analysis, one of the very few on this topic, allows deriving a classification based on the 'time' variable, in which the Internet bubble represents the landmark event (Fig. 1). Before this event, for over two decades groupware had been the only form of social computing; with the turn of the millennium, social software was introduced by some business-oriented communities aiming at revitalizing the Internet. Because of the different nature and purposes of these communities, the boundaries and overlapping of groupware and social software were not clearly demarcated; this created 'interferences' and fragmented social computing.

The choice of the 'time' variable (i.e. a landmark related to the Internet bubble) as a reference for creating a social computing classification presents several problems. For instance, a classification labeling as groupware what was created before the Internet bubble and as social software what appeared afterwards is not very practical. Additionally, as illustrated by Dabbagh and Reo [48], social computing technologies followed an evolutionary trajectory with several lines of continuity, but also innovative aspects. As such, the Internet bubble may have created some pre-conditions for social software, but other factors such as the spreading of the Internet in households have probably had an equally important role in its emergence.

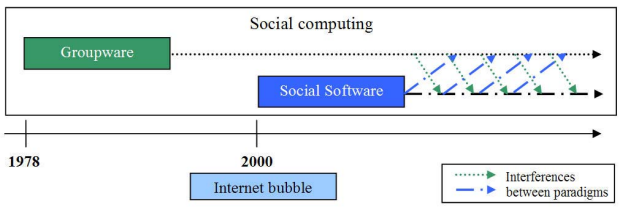

Figure 1. Social software as a by-product of the Internet bubble

Furthermore, this approach does not allow to fully clarifying whether groupware and social software intersect and in which manner. Instead of growing as complementary paradigms, it seems that groupware and social software contaminated each other in a quite disordered manner. A final limitation is represented by the absence of references to the role of the emerging mobile technologies, such as MoSoSo. This may have been simply regarded as a sub-set of social software, as in Shirky's original definition of social software [23], which does not distinguish between desktop or mobile computers.

Promising approaches to social software [5, 49] and social Web [4, 29, 48] classifications have been recently suggested: while they aim at obtaining a clear conceptualization of each paradigm, they do not allow combining them into a more general framework. This goal, however, would be feasible by introducing a simple classification of the three main existing paradigms.

IV. Social Computing: a Classification

The conceptualization of social software "*as an unfolding object for constructing and reproducing social relations*" [5] can be extended to all social computing paradigms and seems an adequate starting point for a classification. In this view, it is the context in which a social practice takes place that defines the social nature of a technological system, not its set of features. Being not only a technological object, but also a social one [5, 28], classifying social computing paradigms along the 'social' and the 'technical' axes seems a good option.

As for candidates of 'social' variables, following the idea of communityware [21], one option would be to differentiate social applications on the basis of a 'social scale' variable i.e. the number of users involved in the interaction. Groupware would be limited to interpersonal and small group communication, while social software to community-related and macro-level interactions (e.g e-citizenship/e-society and other forms of active involvement in institutional and/or organizational processes, such as crowdsourcing). As this classification does not allow to clearly differentiating social software from MoSoSo, it would assimilate the two paradigms.

The spatial focus of social applications could also have been adopted as a classification criterion; this would distinguish paradigms focusing on co-located and proximate social interaction from those enabling social communication at distance. Unfortunately, both groupware and social software address both types of interaction; hence, any classification based on this criterion would be an arbitrary one. Although both social scale and spatial focus appear as reasonable classification criteria, they present the same shortcoming of not permitting to easily associate a social application to the right paradigm. In other words, a classification scheme based on these 'social' parameters would have revealed much overlapping between the paradigms, rendering minimal the differences between them.

A radical approach would be to create entirely new paradigms, such as localware and distanceware, which would embed elements from groupware, social software and MoSoSo. Also in this case, it would be quite difficult to classify applications that can operate, according to the need, as localware and distanceware. Furthermore, if additional new terms such as localware or distanceware are introduced, they may clarify the scope of existing paradigms but at the same time cause an even larger fragmentation of the field. Instead of replacing the existing paradigms of social computing with new ones, a better solution would be to disambiguate them by clearly demarcating their boundaries.

The solid tradition of CSCW and CSCL studies suggests an alternative for the choice of a viable 'social' criterion of classification. Specifically, the core of groupware research concerns formal social interactions oriented at learning or working activities. The interest of groupware research for informal social interactions is only a recent extension demanded by the need to investigate everyday uses of ICT. This is precisely the domain in which social software and MoSoSo have been conceived. Hence, depending on its contextual use for formal or informal interaction, email, messaging or SNS may be regarded as groupware, social software or MoSoSo. This approach would allow applying and comparing the knowledge acquired in groupware research to social software studies - and vice versa - by considering the findings from a different social perspective.

The 'technical' classification variable is associated to the interaction contexts [50] that a specific device typically supports. These contexts range from the static interaction context typical of desktop computers to the more dynamic mobile context in which smartphones or tablets are typically employed. Laptops are often used in static interaction contexts, but also support some forms of mobility. From a technical viewpoint, the process of digital convergence has recently allowed accessing information independently of the device; however, contextual variables have an influence in the way such information is accessed [51]. In turn, the peculiar nature of static and mobile interaction contexts has an impact on the way the social application is designed [52].

By following this logic, groupware spans both the static and mobile dimensions because its research was originally connected to desktop computer environments, but since the Nineties it started exploring social interactions in mobile [24, 25, 26] and ubiquitous [50, 53] contexts. It is more difficult to mark the boundaries between social software and MoSoSo because it requires addressing the fundamental differences and overlapping between desktop and mobile computers.

In its original definition [23], social software encompassed also the dimension of mobile-mediated interactions. This view did not encounter consensus, since MoSoSo was launched as social software that runs on mobile devices [11, 31]. Although neither the number of studies on social software nor MoSoSo is very extensive, the significance of MoSoSo can be acknowledged by restricting the scope of social software to informal interactions in static interaction contexts. Consequently, MoSoSo would be associated to informal social interactions in mobile interaction contexts. This choice does not override Shirky's definition of social software [23], but simply reconsiders its scope by taking into account what happened before (i.e. groupware) and after (i.e. MoSoSo).

TABLE I. A CLASSIFICATION OF SOCIAL COMPUTING PARADIGMS

	Formal Social Interaction	Informal Social Interaction
Static Interaction Context	Groupware	Social software
Mobile Interaction Context	Groupware	MoSoSo

The suggested classification is therefore based on two main dimensions, namely the style of the social interaction, formal or informal, and the nature of the interaction context, static or mobile. Table 1 summarizes the scope of the three main existing paradigms of social computing.

V. CONCLUSIONS

In less than three decades, groupware, social software, MoSoSo and a number of less known, but significant paradigms of social computing have emerged. Typically, more attention has been paid to the launch of a new paradigm than to the clarification of its relationship to the existing ones. This has produced a weak conceptualization of key social computing concepts, and a high fragmentation of the field, with relevant studies spread across disciplines and lack of standard approaches to compare them both from social and technological viewpoints. In many cases, the unclear boundaries between similar areas of knowledge have not been intentionally produced, but they rather emerged in parallel in different academic domains and geographical areas. However, the increasing relevance of interdisciplinary research requires conceptual tools, such as classifications, to create a common language for collaboration between the various research communities. Considering the growing importance of social computing on society and the economy, it is time to combine the social computing research traditions in order to develop a joint research agenda. The introduction of a classification of social computing paradigms is seen as a first step towards this goal. To our knowledge, not much work on this issue is available and certainly the proposed classification scheme is far from being perfect. Nevertheless, this attempt represents a starting point for an interdisciplinary discourse among academics and practitioners on the consolidation and development of social computing – an abstract concept that has become deeply embedded in the lives of billions of ICT users worldwide.

Various applications of the social computing classification and its developments are envisaged. First, a clear definition of the basic terminology would allow a more precise assessment and comparison of the true impact of social computing as a whole. Currently, studies on social computing cannot be easily compared because using ad-hoc definitions and methodology [3]. This also prevents development of accurate generalizations of local and international trends, and solidly grounded policies and market research. The current definition of social computing, being at the same time vague and broad, renders targeted investments and plans very challenging.

A second important outcome is of technological nature and concerns the enhancement of the design of social computing applications on the basis of a common understanding of its conceptual building blocks. This approach was adopted by Lugano [42] to develop a three-layered conceptual model of MoSoSo design inspired by Rheingold's descriptions of smartmobs [54] and by the network theory of social capital [55]. After recognizing the emergence of digital communities as an effect of the convergence of the offline, online and mobile dimensions of interaction, MoSoSo was reconceptualized from urban entertainment gadget to general-purpose social platform with emancipatory potential. As such, MoSoSo allows users to attain individual and/or collective purposive action goals through the access to social resources embedded in mobile social networks. Based on the given classification, this model could be also extended to groupware and social software, and evaluated on the basis of contextual interaction goals (e.g. mobilization for political protest, individual job search) and social structure (e.g. family, large crowd).

Additional research is needed to develop the classification model; a possible direction is to extend it by integrating the insight offered by recent efforts in clarifying the conceptualization of social computing paradigms through socio-technical approaches [4, 5, 29, 48, 49].

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