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ENGINEERS ARE USING SOCIAL MEDIA FOR WORK PURPOSES

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1. Introduction

Designing is never a solitary process. It is an information intensive social interactive process e.g. [Bucciarelli 1984], [Perry and Sanderson 1998], [Eckert et al. 2005], and a number of studies have emphasised the importance of well-functioning engineering design communication for project success e.g. [Sosa 2002], [Stempfle and Badke-Schaub 2002]. Researchers in engineering design have explored current and anticipated future information and knowledge requirements of engineers throughout the entire product life cycle e.g. [Court et al. 1993], [Marsh 1997], [Heisig et al. 2010], [Jagtap and Johnson 2011]. Researchers have also explored what kind of channels engineers use when searching for information. Despite the ubiquitous use of email e.g. [Wasiak et al. 2010], it appears (still) to be the case that engineers primarily retrieve information through face-to-face communication with their colleagues [Rosenberg 1967], [Allen 1969], [Hertzum and Pejtersen 2000], [Anderson et al. 2001], [Fidel and Green 2004]. This implies that the social connectedness of who one knows matters [Larsson 2005].

Given the nowadays often distributed nature of product development, advancements in technology, changes in work patterns, and the tendency of engineers to rely on their colleagues and people they can easily reach, social media may be an obvious choice for information seeking and knowledge sharing. The term social media is used broadly here so as to denote a group of products and services that enable social interactions in the digital realm, such as blogs and social networking platforms [Kaplan and Haenlein 2010], [Chui et al. 2012]. When considering intra- and inter-organisational knowledge sharing across the value chain in particular, a 2012 McKinsey report estimates the economic impact of social technologies to be more than $1 billion annually across the value-chain with 2/3rds stemming from social business collaboration. Moreover, an improvement in productivity of knowledge workers is estimated to increase between 20-25% [Chui et al. 2012]. Anecdotal evidence suggests, however, that social media is not being used for work purposes, but rather for ‘hanging out’ and ‘having fun’ e.g. [EE Times 2012], [Parker and Thomas 2012]. We wondered whether this is really the case in design practice and contacted engineers and engineering managers through an electronic survey by asking the following main research question: *For what purpose do you use social media during your daily engineering-related tasks?*

This paper starts with a brief literature review on the role and use of social media in product development in section 2. Section 3 presents our data acquisition and analysis approach. Then, the paper continues by detailing its main contribution: our findings describing what purposes engineers are using social media for in section 4. Section 5 discusses our results with respect to extant literature, and Section 6 concludes the paper with a summary and outlook.

2. Literature background: Research on the use of social media

Within corporate communication-, marketing and consumer research and innovation management, a great amount of recent studies have investigated the use of social media as a way of involving employees, suppliers, customers and end-users [Hearn et al. 2009]. Through crowdsourcing a broad base of users participate online in a voluntary manner and bring their knowledge and experiences to bear on problems the 'crowdsourcer' aims to solve [Estellés-Arolas and González-Ladrón-de-Guevara 2012]. This is transforming the practice of engineering and product design.

Over many years, researchers in the field of computer supported cooperative work (CSCW) have focused on the development and implementation of social groupware [Grudin 1994], [Olson and Olson 2003]. It is widely accepted that work space systems are vital for distributed communication [Eckert and Stacey 2001] and the use of CSCW tools enhances design communication [Chiu 2002] in collaborative design [Maier et al. 2011], [Kleinsmann et al. 2007]. CSCW tools have been successful in increasing the amount of information available to the user [Khoshafian and Buckiewicz 1995] and have helped to increase awareness and transparency [Moenaert et al. 2000] of what other people are working on in the development process [Gutwin and Greenberg 2002]. Yet, social media, of which some argue that they can be seen as a continuation of traditional CSCW tools [Hölttä and Eisto 2011], may be more suitable for increasing the visibility of people and information, of who knows whom and who knows what. Such tools also encourage the shift from information pushing to information pulling [Hölttä and Eisto 2011]. Furthermore, as Kotlarsky and Oshri [2005] argue, an introduction of organisational mechanisms that create social spaces between people is required in order to achieve successful collaboration, especially in globally distributed teams [Kotlarsky and Oshri 2005]. Social media tools may create such social spaces and several studies argue that the new technologies may provide new opportunities to facilitate tacit and experiential knowledge sharing [Hsia et al. 2006], [Abidi et al. 2009], [Osimo 2008], [Steininger et al. 2010].

Looking through the core engineering design research journals (including Research in Engineering Design, Journal of Engineering Design, Design Studies and AI EDAM) and core conferences (DESIGN, ICED, ASME DETC-DTM and CIE tracks) reveals that not many articles are specifically dealing with the use of social media. Yet, the guest-editorial of a recent AIEDAM special issue on studying and supporting design communication points to a development in research in design communication from asking how information may best be connected and represented toward asking how an active and embodied engagement in the design process may best be supported, for example, through multisensory digital–interactive media [Maier and Kleinsmann 2013].

Bertoni et al. [2012b] give evidence for the claim that social media establish possibilities for communication despite geographical distribution and furthermore describe how social media support a more bottom-up creation and sharing of knowledge. Social media is not domain- or discipline-specific, thus the tools can be used outside the boundaries of traditional knowledge management systems [Bertoni et al. 2012a]. Social media leverage cross-functional sharing and networking across borders and may enhance the process of feeding crucial lifecycle knowledge and lessons learned back to early design practices [Bertoni et al. 2012a], [Chirumalla et al. 2013].

Hölttä and Eisto [2011] present new communication structures in the buyer-supplier relationship when using web 2.0 technologies. Their results show that through the use of social media tools, the response base during community sourcing within the product development network is widened. Employees improve their situational awareness, network transparency increases, and new social spaces may be created, enabling new collaboration possibilities that were not there before [Hölttä and Eisto 2011]. Most recently, Gopsill et al. propose an approach to capture informal product knowledge with the use of social media [2012] and a more extensive social media framework to support engineering design communication [2013]. The framework includes a description of how the communication process is created and evolves when using a social media tool and a classification matrix to identify the purpose of any communication. The matrix consists of several tagging types that identify the communication (e.g. Idea, Help, Issue) and the responses (e.g. Opinion, Experience, Observation). We add to the social media framework, by addressing what specific purposes engineers currently use social media for. Thereby, we validate the tagging types possibilities of the classification matrix.

However, research focusing on social media and engineering design communication e.g. [Hölttä and Eisto 2011], [Gopsill et al. 2012, 2013] has yet not explored what purposes engineers are using social media for. Our research contributes towards filling this gap.

3. Method: Towards finding out what engineers use social media for

3.1 Research questions, data acquisition and sample size

As part of a wider research programme on information seeking and knowledge-sharing in industry, we asked engineers and engineering managers employed in Denmark three questions: a multiple choice question (i) Which social media tool/tools do you **use** during your daily engineering-related tasks? An open question (ii) For what **purposes** do you use social media during your daily engineering-related tasks? And another multiple choice question (iii) In your experience, is the **importance** of social media for information and knowledge generation to support your daily engineering-related tasks increasing, remaining about the same, decreasing? Bearing in mind the characterisation of social media as products and services that enable social interactions in the digital realm, thus allowing people to connect and interact virtually as given earlier, a list of tools to select from was created based on experiences from Fink et al. [2011].

The survey was sent to more than 320 companies and organisations, and 136 valid responses were received.

The sample of valid answers covers all company sizes, with 50% being large companies with more than 1000 employees. In all, 17 industry sectors were represented (e.g. Automotive, IT and Telecommunications, Electronics) and the most common roles were design engineer, production engineer, software engineer, and managers conducting engineering-related tasks. The broad range of respondents' roles ensured that the results were representative of engineering work in general.

The amount of valid answers varies for the three questions. For the multiple choice questions, 134 respondents addressed which tools they use (i) and 130 people answered the question related to importance in the future (iii). A total of 77 respondents (52% engineers and 48% managers) answered what purposes they are using social media for when working on engineering-related task (ii), addressing a total of 131 different purposes.

3.2 Data analysis and interpretation

For the main research question on what purposes social media are being used during daily engineering-related tasks, we coded the data following an inductive bottom-up strategy. This was inspired by the process used in Heisig et al. [2010] in their study on information needs and retrieval in industry in the UK. The mentioned purposes were first identified as a set of keywords which were subsequently grouped into categories (e.g. information, networking). The label of the categories was kept as close as possible to the natural language of the responses in order to retain the meaning we inferred from their sentences. Two researchers coded the data independently. In the first round, the coded responses and category lists were compared and a single category list was created. In the second round, and to ensure inter-coder reliability [Cho 2008], the two researchers independently coded the data again, using the agreed list of categories.

From the 77 responses stating 131 purposes, 40 categories were created. Agreement between the researchers was 91,1%, fulfilling the 80% inter-coder reliability rule proposed by Miles and Huberman [1994].

Our findings with respect to specific purposes of social media use will be compared to the communication classification matrix within the social media framework created by Gopsill et al. [2013].

4. Results

Overall, we can say that industry practitioners are using social media during their daily engineering work. In Section 4.1, we start by presenting which social media tools are being used and by which generation. Section 4.2 presents the results regarding what purposes social media are used for and

differentiates also between engineers and engineering managers. Section 4.3 shows the respondents estimation on the importance of using social media for engineering work-related tasks in the future.

4.1 Which social media tool/tools are used during daily engineering-related tasks?

First of all, 88% of engineers and managers performing engineering-related tasks use social media tools for work purposes. Only 16/134 = 12% said that they do not (see Table 1).

Table 1. Which social media tool/s (n=134)

Answer	Response	%
Blogs	17	13%
Facebook	20	15%
Google	92	69%
Internal Web 2.0 tools (RSS feeds, Video sharing, Blogs, etc.)	7	5%
LinkedIn	53	40%
Microblogging (e.g. Twitter, Friendfeed)	3	2%
MySpace	0	0%
Photo sharing (e.g. Flickr)	4	3%
Own communities on the internet	27	20%
Own communities on the intranet/extranet	45	34%
Second Life	0	0%
Skype	23	17%
Video Portals (e.g. YouTube)	5	4%
Wikipedia	46	34%
Xing	1	1%
Other/s	17	13%
I do not use social media for work purposes	16	12%

Our results show that a broad selection of tools is used by managers and engineers in the Danish industry. Social media in relation to engineering work are used for everything from short (e.g. Twitter) to more extensive (e.g. Wikipedia) text, photo sharing (e.g. Flickr) to video sharing (e.g. YouTube), and profile sites (e.g. LinkedIn) to phone calls (e.g. Skype). Google is most frequently used, followed by LinkedIn, Wikipedia, Own communities on the intranet, Own communities on the internet, Skype, etc. A possible example for 'other' could be QR codes. By offering such a broad spectrum of use scenarios, the tools seem able to fulfil the needs and requirements of engineers in relation to many divergent work tasks. The tools offer different methods to share experiences, receive and send information, and collaborate. By using one particular tool you can address people, knowledge and/or information appropriate for a specific task. This is one of the advantages of social media and enforces the argument e.g. [Gopsill et al. 2013] that social media is applicable to beneficially support engineering communication.

It is generally presumed that young generations use social media to a higher extent than elder generations as the younger ones have grown up using the technologies. Our results provide evidence to that. Even though across generations, there is a similar tendency with respect to the most frequent tools used overall, i.e. Google, LinkedIn, Wikipedia, social media such as Microblogging (e.g. Twitter), Photosharing (e.g. Flickr) and Internal web 2.0 (e.g. RSS video sharing) are only used in the 25-34 and 35-44 age groups, with the biggest block coming from the younger engineers.

In addition, our results show that social media are used by all age groups of the work force for work-related purposes. This indicates that social media is not just a recent 'trend' used by the young generations but that it is used pervasively and is part of the daily work routines in engineering.

4.2 Purposes of the use of social media in relation to work

Individual purposes (e.g. description of concepts, examples, templates) amounted to 131 in total (see

Figure 1). The results show an extensive list of different purposes addressed and thus also imply potentially different usage scenarios. Out of the total number of 40 created categories, overall, social media are mostly used to search for information, knowledge, solutions and to network.

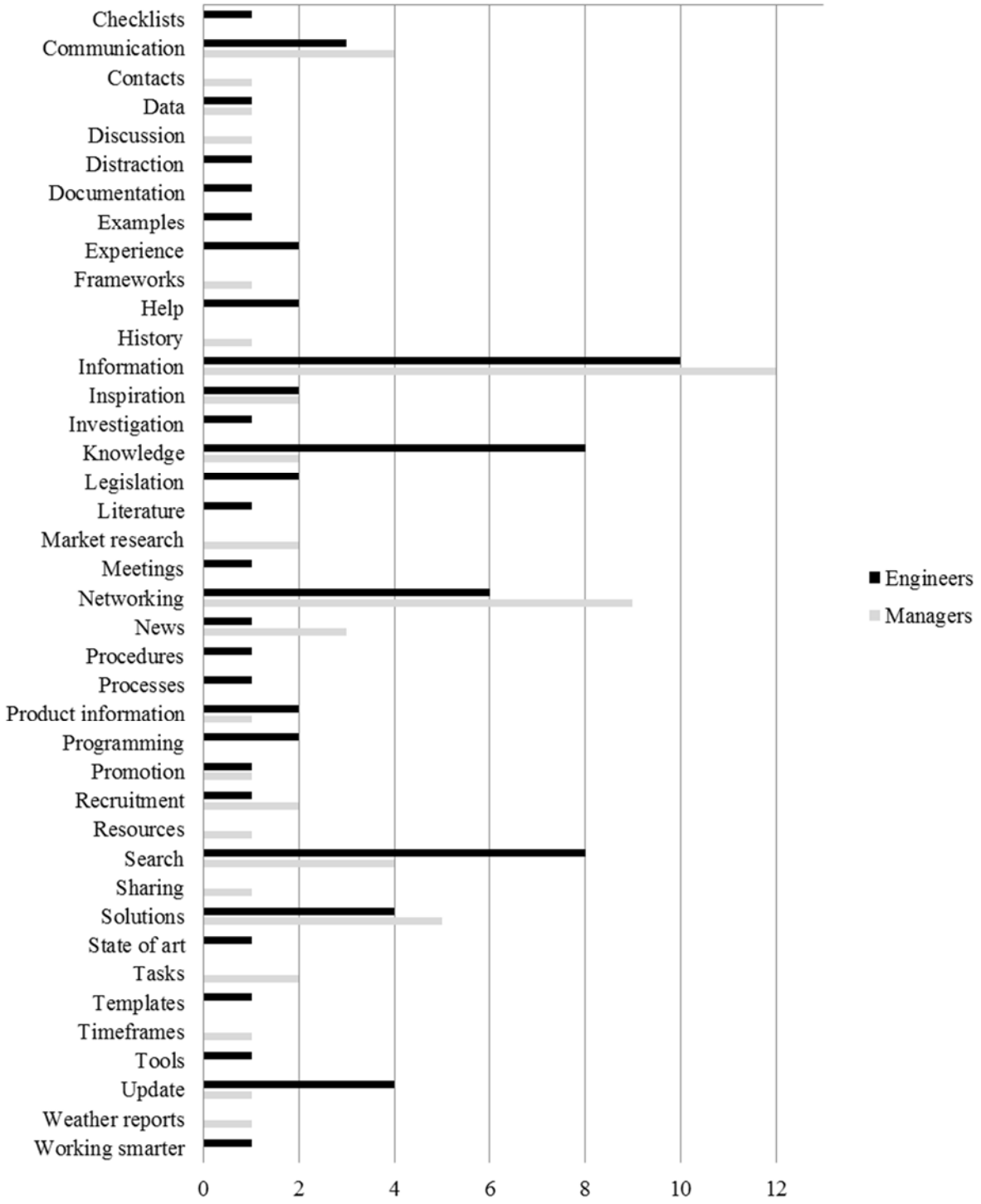

Figure 1. Purpose of use (n=131 purposes/n=77 respondents)

4.2.1 Most frequently elicited categories

Each category has been created based on the direct quotes from the respondents (see Table 2).

Table 2. Individual purposes grouped in categories for social media use

Category	Examples	Frequency	Percentage of respondents
Information	*'searching for information (...)'; 'information'; ' gathering of information'; 'information retrieval'*	22	28,6%
Networking	*'to keep business network'; 'networking with colleagues from other related (...) projects'*	15	19,5%
Search	*'(...) internet search'; '(...) personal search'*	12	15,6%
Knowledge	*'a quick access to gain knowledge'; ' gain knowledge on industrial sectors'; 'knowledge'*	10	13,0%
Solution	*'sometimes it is possible to find solution'; 'sharing/finding/saving solutions'*	9	11,7%

Information: Search, handling and processing of information takes up a significant time of engineers and managers [Aurisicchio et al. 2013]. The inherent complexity of product development processes results in engineers dealing with a vast amount of information at all stages of the design process. Representation of the right information can lead to significant timesaving and enable reuse of information and knowledge, thus preventing people from 'inventing the wheel' again and again [Maier et al. 2009].

The category was by far the one where most quotes stating the purposes were grouped under (28,6%). This indicates that social media is used for information gathering of all kinds of subject matters ranging from *new topics* to *specific products*. Many of the other responses could have been interpreted as information seeking regarding a certain topic as well; however, this category only features the responses directly stating information (see Table 2).

Due to the considerable attention towards *information* and assuming the requested information is found, our results indicate that social media tools may well be on their way towards satisfying information requirements of engineers.

Networking: The category n*etworking* displays the second highest amount of answers. When describing answers collected in this category the respondents said sentences such as *'(...) to find people I need to talk to'* and *'it links people socially together in a "powerful" relation'*. This result is not surprising, as one may argue that this is the very reason the tools are generated for. Due to the radically changing industrial contexts such as digital manufacturing and geographical distribution, networking in form of collaboration through computer-mediated communication has become an essential part of the daily work of engineers and managers.

Search: Purposes fitting the created category *search* has also been addressed several times by the respondents. The responses in this category are only the ones directly stating search (e.g. *'(...) internet search' and 'data and information search')*. The category combines many of the other addressed categories and covers searching for information, knowledge, personal, solutions, etc.

Knowledge: The respondents also addressed considerable attention towards answers regarding knowledge. The category contains answers such as *'exchange of knowledge', 'gain knowledge on industrial sectors'* and *'knowledge'*. Equally to the conclusion of the category *information*, the high amount of purposes listed by respondents that is grouped under the category *knowledge* may also point that the information needs and requirements [Heisig et al. 2010] of engineers and engineering managers may well be met by using social media.

***Solution*:** Solutions help people move on and prevent time wasting on things that have already been done once. The presence and perhaps collaborative generations of solutions supports reuse of knowledge, fusing of new ideas and thereby preventing double-work. The category collect answers like *'sometimes it is possible to find solutions'* and *'looking for new input/solutions (...)'*.

The analysis identified differences in the purposes of using social media depending on the role of the respondent. We report the differences between engineers and managers.

4.2.2 Different purposes mentioned by managers and engineers?

Overall, all respondents mostly use social media to search for information, to network, and to find

solutions. Engineers tend to mention more purposes pointing to information search, knowledge search, solutions, and updates. Managers also point to information search, directly followed by networking. Purposes only mentioned by engineers are: Checklists, Distraction, Documentation, Examples, Experience, Help, Investigation, Legislation, Literature, Meetings, Procedures, Processes, Programming, State of art, Templates, Tools and Working smarter.
Purposes uniquely mentioned by managers are Contacts, Discussion, Frameworks, History, Market research, Resources, Sharing, Tasks, Timeframes and Weather reports.
Our findings indicate that engineers are using social media for a wider variety of purposes than managers. While managers have addressed purposes collected into 23 different categories, engineers have directed purposes collected into 30 different categories. Our findings also show that engineers use social media for more technical product-oriented purposes and for more details (e.g. processes and examples) than managers. Managers appear to use social media for more general networking and administrative purposes.

4.3 Importance of social media in the future

There appears to be an overwhelming consensus among the engineers that the importance of social media for their work in the future will remain about the same with some pointing towards an increase in importance (see Figure 2). The tendency in the answers from managers points clearly towards increase in importance.

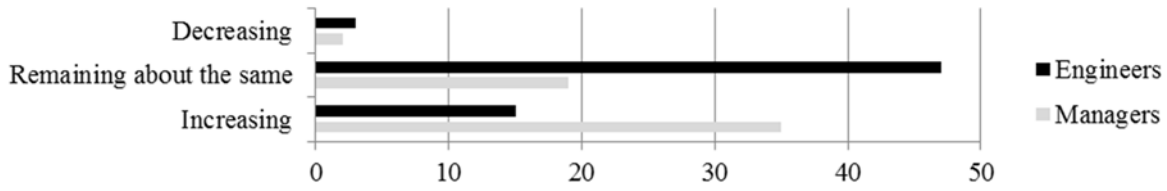

Figure 2. Importance of social media in the future (n=130)

5. Discussion

Our findings contribute to research on the use of social media in engineering design in the following way: (a) by providing empirical evidence for the actual use of social media in engineering practice; (b) by confirming the argument made by Gopsill et al. [2013] that social media provides the features necessary to satisfy identified requirements for design communication; and (c) by validating and adding specific purposes of use to the communication classification matrix presented within the social media framework by Gopsill et al. [2013].
Our analysis and results falsify the suggestion mentioned in popular literature at the start that social media is only being used for fun and personal reasons. As shown by the results and the analysis social media may help introducing organisational mechanisms that create social spaces between people. Social media support a more bottom-up creation and sharing of knowledge and reviewing our results contributes to the identification of possible benefits of such a bottom-up knowledge sharing strategy. However, the purpose of social media is not to straightforwardly replace traditional knowledge management systems [Bertoni et al. 2012a], but rather to contribute by providing more visibility and possibilities for communication and collaboration across the knowledge life cycle and enhance new work methods like crowdsourcing.
Literature shows that engineers still seek to gain knowledge from face-to-face communication. Nonetheless, the comprehensive use of social media tools and the corresponding selection of purposes addressed by our results reveal an acknowledgement of social media tools by practitioners. The often geographically distributed nature of product development has created a need for facilitation of communication no longer possible to reach by synchronous face-to-face channels. Social media is being discussed as an alternative to solve this problem by leveraging cross-functional knowledge and information sharing and networking across borders. Our results add to this argument by showing that

the tools are already commonly used in practice and the purposes stated by the respondents indicate a widespread potential of the tools.
By introducing several tagging types (e.g. Idea, Help, Issue, Opinion, Experience, etc.) the communication classification matrix in the social media framework [Gopsill et al. 2013] serves to categorise and clarify the content of any communication, thereby, making it easier to find the right information and knowledge to capture, share and reuse. Networking is the fundamental part of social interaction and may be supported by social media. Tagging types in general related to social interaction are not present in the classification matrix which is only focusing on specific purposes. To allow and contribute to the online interaction and knowledge sharing overall general subjects should be present as tagging types enhancing general discussions that later on may develop into more specific content which then could be tagged in more details. We argue that sub-tagging types would be advantageous to general subjects. However, initiation of communication with only general clarification must be equally possible as more specific purposes.
The modern practises of engineers require new ways of interacting and collaborating. A need for 'organic' and flexible knowledge sharing technologies has arrived. Cross-functional sharing and networking across borders in a rapidly changing environment are not adequately addressed in traditional knowledge management systems. Social media tools could satisfy this problem. As shown in the analysis and results, these tools meet the new emerged requirements and can therefore play a vital role to enhance engineering activities in the future.

6. Conclusions and outlook

This paper discussed the purposes of using social media by people doing engineering-related tasks and potential benefits of using social media are described. In contrast to claims in popular literature that social media are only used for 'fun' purposes, our findings reveal that 88% of the respondents use social media in relation to work and the most addressed purposes are '*Information', 'Networking', 'Search', Knowledge'* and '*Solutions'*. Based on these findings, we suggest an expansion of the communication classification matrix to additionally encompass more general tagging types. Our findings show that social media are used for a comprehensive set of purposes. This indicates that required information, adequate representation of information and possibilities of sharing information and generating knowledge are supported through the knowledge lifecycle. Our analyses and results show that social media fits the evolution of product development practices, thereby, the tools may become a vital part of engineering activities for cross-functional knowledge and information sharing and networking across borders.
Based on these findings we suggest following up by investigating the implications of the use of social media tools for the engineering design process and examining further how engineers evaluate the reliability of identified information and knowledge. Analysing data traces left by social media may give us insight into design communication practices and design rationale. This may further lead to defining requirements for knowledge sharing systems based on web 2.0 functionalities and how they may integrate with existing product life cycle management (PLM) systems in industry.

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