EMSoD — A Conceptual Social Framework that Delivers KM Values to Corporate Organizations

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***Abstract*—As social software is becoming increasingly disruptive to organizational structures and processes, Knowledge Management (KM) initiatives that have hitherto taken the form of a 'knowledge repository' now need redefining. With the emergence of Social Media (SM) platforms like Twitter, the hierarchical boundaries within the organization are broken down and a lateral flow of information is created. This has created a peculiar kind of tension between KM and SM, in which one is perceived as threatening the continued relevance of the other. Particularly, with the advances of social media and social software, KM is more in need of delivering measurable value to corporate organizations, if it is to remain relevant in the strategic planning and positioning of organizations. In view of this, this paper presents *EMSoD* — *Enterprise Mobility and Social Data* — a conceptual social framework which mediates between KM and SM to deliver *actionable knowledge* and *employee engagement*. Meanwhile, given that the main objective of this research is in the delivery of KM value to corporate organizations, this paper devises some mechanisms for measuring *actionable knowledge* and *employee engagement*, both as parameters of KM value.**

***Keywords*—social-media; tacit-knowledge; actionable-knowledge; twitter; SMEs; employee-engagement; enterprise-mobility; social-network-analysis; folksonomy.**

I. INTRODUCTION

Social media have become viable sources of data from which corporate organizations can discover knowledge and insights for their strategic competitive advantage. In [1], a case of a medium-sized enterprise that lacks a significant social media presence, is explored with regards to how public Twitter data is exploited to discover actionable knowledge that propels the enterprise's strategic competitive advantage. The work utilises text analysis techniques to make sense of the unstructured social media data harvested through Twitter's Streaming API.

The work in [1] is a cascading of our original research exploring the question of how social media platforms like Twitter can deliver Knowledge Management (KM) values to corporate organizations. As a form of social machinery that facilitates human interaction on the Web, social media enable people to create new knowledge by sharing and synthesising knowledge from various sources [2]. Using this social infrastructure as leverage for corporate knowledge management is the main objective of the framework presented in this paper.

In this paper, we discuss our motivation for exploring the question of how social media platforms like Twitter can deliver KM values to corporate organizations. We present the ***E**nterprise **M**obility and **So**cial [media] **D**ata* **(EMSoD)** framework, our proposed conceptual social framework, with KM value at its core. We provide an overview of our previous work that culminates in an important measure of KM value — *actionable knowledge* — upon which a significant business decision is made by a case study organization. This is underpinned by the fact that the real essence of knowledge is its actionability, especially when it contributes to the advancement of a proposed undertaking [3]. Measuring the value of such contributions has been one of the main issues of disagreement in Knowledge Management, which is why we devised a mechanism for measuring the KM value which our framework helps in delivering to corporate organizations.

Moreover, our framework identifies another important measure of KM values, which is *employee engagement*. Included in this paper therefore, is a report on a social network analysis of @*unisouthampton*, the Twitter handle for the University of Southampton, with the aim of examining the impact of the structure of the network on employee engagement.

The rest of this paper is organised as follows: Sections II and III provide some background to this study, with the aim of setting out the research motivation for our framework. Section IV presents the ***EMSoD*** social framework, describes its basic elements and discusses the central position of Knowledge Management Value (KMV) as the cynosure around which other basic components of the framework revolves, as well as its (KM value) measurement. In Section V we re-present our previous work on knowledge discovery that culminates in *actionable knowledge* as a measure of KM value. Also included in this section are further insights from recent data on the same subject. Sections VI and VII discuss *actionable knowledge* and *employee engagement* as a measures of KM value, respectively, with their measurement mechanisms. Section VIII concludes the paper with recommendation for corporate organizations and discusses indications for future work.

II. BACKGROUND AND RESEARCH MOTIVATION

KM within organizations has traditionally been through a top-down, process approach [4, p.7][5] which precludes employees from collaborating and/or participating in the process of creating and sharing valuable knowledge that are relevant for the organizations competitive advantage. In making KM a part of everyone's job [6, p.107], the top-down approach to KM is being broken down by current and emerging Web technologies like microblogs (e.g., Twitter), social media/networking (e.g., YouTube/Facebook), and multimedia chat platforms (e.g., Skype) [7]. These are pervasive technologies, and are most profound in their capabilities to, in the words of Mark Weiser of Xerox Lab in [8], *weave themselves into the fabrics of everyday life until they are indistinguishable from it*, thanks to the ubiquity (and consumerisation) of mobile devices like tablets and smartphones.

In recent times, these devices have woven themselves around us in so much so that employees are compulsively using them to keep in touch with friends and families even while at work. Many organizations have therefore, already subscribed to the theory and practice of enterprise mobility on the grounds that, allowing employees to access corporate systems and data over these devices (BYOD) enhances productivity while also helping to maintain work and life balances [9]. It also enhances knowledge sharing within the organization in its capacity for fostering discussions over documents and thereby enabling organizations to build social environment or communities of practice necessary for facilitating the sharing of tacit knowledge [10] [6, p.26].

Tacit knowledge is usually in the domain of subjective, cognitive and experiential learning; it is highly personal and difficult to formalise [11, p.478], which is why Michael Polanyi classifies tacit knowledge as one class of knowledge for which we cannot tell as much as we know [12]. How then do we capture and/or engineer this tacit knowledge being inadvertently generated by employees in the enterprise mobility and social media space? This paper attempts answering this question from a big social data perspective, drawing insights from the literature, using a conceptual social framework - EMSoD. Moreover, a vision of a knowledge social machine is encapsulated in this framework, which leverages the flow of tacit knowledge on existing social interactions within the boundary of the organization as defined by its enterprise mobility strategies. This social machine has the organizations workforce as its user base, using their own devices (BYOD) or using the company-owned devices that have been personally enabled for them (COPE). The social machine produces company-relevant insights and knowledge as output, taking its input from a combination of internal data (enterprise social media, transactional data, system/web logs, etc.) and open/public data, together with the active participation of the employees in the process of knowledge management, as illustrated in Figure 1.

Meanwhile, the traditional top-down approach to KM mentioned earlier has also resulted in KM becoming a lacklustre concept, considering the perceived lack of maturity and the general state of apathy in the field, as evidenced in a recent Knowledge Management Observatory survey referenced in [13] and the 2015 follow up of same report [14]. More so, there is hardly any sector in which organizations have not embarked on a Knowledge Management program or project to improve on their organization practice; research has shown that knowledge-oriented management has a significant influence on performance, in spite of the image problem suffered by KM due to its overselling by vendors and consultants in the 1990s [15].

To shake off this image problem and to douse the perceived tension between KM and social media [16], participants in a recent massive survey into the future of KM by the Global Knowledge Research Network (*GKRN - Network of Researchers sharing an interest in undertaking joint research on knowledge management*) published in [15], regard social software as an advancement of the KM field. The research suggestion in this regard, places clear emphasis on the economic, organizational and human context factors related to the use and implementation of this new social software technologies. This organizational and human context factor is what culminates in the concept of Enterprise Social Networking, fondly referred to as Enterprise 2.0 - another concept made possible by the advances in social media . Although, some of the proponents of Knowledge Management were initially hostile towards the new concept of Enterprise 2.0 as propagated by [17], describing it as a new wine in an old bottle, Davenport's [18] earlier comment in a HBR *(Harvard Business Review)* blog post is worth noting:

> "If E2.0 can give KM a mid-life kicker, so much the better. If a new set of technologies can bring about a knowledge-sharing culture, more power to them. Knowledge Management was getting a little tired anyway."

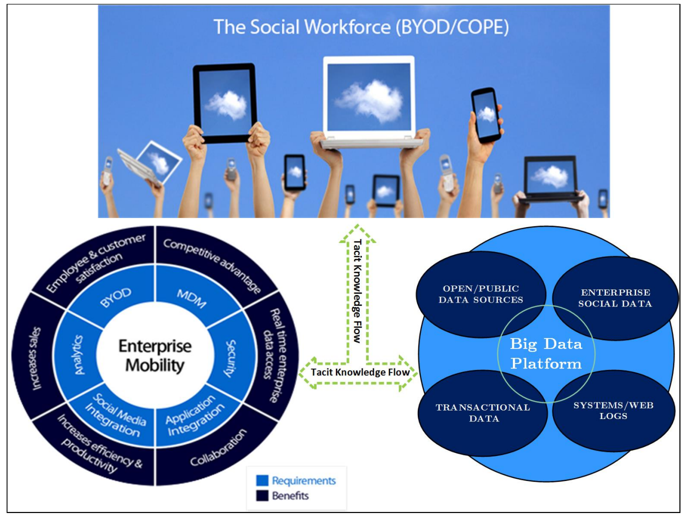

Figure 1: Tacit Knowledge Flow

These new sets of technologies that can bring about a knowledge sharing culture has been found in social media and their social networking capabilities, as enabled and popularised by the consumerisation of mobile devices. KM can therefore, be repositioned within these innovative technological trends of enterprise mobility and social media analytics, which can be exploited for rejuvenating the concept and practice of KM, in consonance with Delic and Riley's [19] assertion that,

> "The field of knowledge management, having passed several hypes and disappointments, has yet another chance of reappearing in totally new technological and social circumstances."

The overarching issue recognised in the GKRN research mentioned above is the challenge for KM in being able to deliver measurable value for businesses. The conceptual social framework (see Figure 3) presented in this paper places the value proposition of KM at the centre of organizational knowledge management processes. To the best of our knowledge, this is the first framework of its kind that seeks to use the convergence of enterprise mobility and social (media) data as leverage for corporate knowledge management in such a way that corporate organizations can derive KM value from the synergy. Meanwhile, we did not arrive at this framework on the fly. The core elements of the framework have emanated from a rigorous review of relevant literature, the process of which is described in Section III.

III. The Making of the Social Framework

With regards to the image problem suffered by KM in the 1990s [15], there has been an increasing effort by KM consultants and academics, since the 2000s, to explore how the growing trends of enterprise mobility — as manifest in the surge in mobile devices and applications — can be exploited for corporate Knowledge Management. This is evident in Knowledge Management literature, which abounds with issues and concerns about Enterprise Mobility.

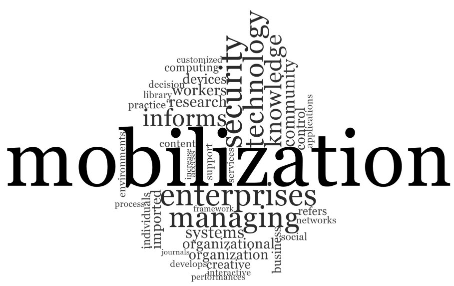

Figure 2: A Word Cloud for Mobilization from the Literature

For this research, about 160 KM literature materials published between 2004 and 2016 were examined. These include books, book sections, conference papers, journal articles, reports, thesis and web pages. The term, *'mobilization'* — with variants of mobile, mobility, mobilize — is topmost in the list of Top 50 most frequently used words in these KM literature (see Figure 2).

IV. EMSoD — The Conceptual Social Framework

E*nterprise* ***M****obility and* ***So****cial [media]* ***D****ata* **(EMSoD)** is a conceptual social framework that exploits the convergence of enterprise mobility and social media data as leverage for corporate Knowledge Management. The proposed framework is presented cyclically in Figure 3 to emphasise the interdependence of its five core elements — Managed Platform, Social Media, Knowledge Discovery, Tacit Knowledge and, KM Values. The cyclical illustration of the framework also emphasises that changing one element has an impact on other elements and on the capability for the framework to deliver the intended KM value at its core. Each of the five core elements are examined in this section.

A. Managed Platform

This framework supports the vision of a knowledge social machine, which serves as a leverage for the flow and conversion of tacit knowledge, on existing social interactions within the boundary of the organization, as defined by its enterprise mobility strategies. This social machine has the organizations workforce as its user base, using their own devices (BYOD - Bring Your Own Devices) or using the Company-Owned devices that have been Personally-Enabled for them (COPE). With BYOD for example, the choice of the brand, functionality and installed apps are entirely that of the employee and, when these devices are allowed to be used in accessing the corporate data from anywhere the employee may be located, it exposes the organization to the risk of compromise of the privacy and security of its corporate data. Also, because there are as many different devices as there are employees, the organization is faced with the challenge of how to integrate these disparate devices into a platform for ease of support and interoperability. To mitigate against these constraints of privacy, security and interoperability, there is need for the organization's enterprise mobility strategy and social media data to be contained within a managed platform.

Enterprise Mobility Strategies

> "*Given the plethora of devices, operating systems, solution providers and overall mobility commoditisation, how will technology leaders meet their employees needs and offer mobile access to corporate system, data and information they crave, in order to maximise the potential for productivity and the competitive advantage that follows?*"

The above quote is from Mihaela Biti, the Programme Director of *Enterprise Mobility Exchange*, in her *Foreward* on the Global State of Enterprise Mobility [20] as reported by the company, following a global survey. The report shows that the bulk of the respondents are IT, Mobility and Technology workers, an industry where mobility is already widely embraced. Also, about 30.1% of the respondents have their operations globally, which presupposes they would have to mobilise anyway. Nonetheless, the mobility agenda for these enterprises are largely for automation aimed at operational performances and not for the facilitation of social interactions among employees. For example, when UPS successfully introduced the handheld Delivery Information Acquisition *mobile* Device (DIAD) for their drivers in 1991 [21], the question arose as to whether the next move was for customers to be able to quickly look and see real-time location of their driver and contact them directly. An answer to this question is FEDEX Mobile Solutions which allows customers to conveniently track their shipments, find the nearest FedEx station or drop-box, etc. An enterprise mobility strategy that is geared towards simple automation with mobile devices is good for enhancing operational efficiency of an enterprise. Of course, this is a source of competitive advantage, but only up to the point where they are unique to the company and as such, cannot easily be replicated (e.g., the Walmart Satelite investment [22]).

However, the consumerisation of mobile devices has meant that the competitive advantage that a company derives, if any, from automation or implementation of mobile solutions will soon erode when competitors have adopted the same or similar solutions. In essence, a true competitive advantage is attainable when businesses and organizations proceed to the second - and third - order of organizational change, which are to *informate* and *transform* as highlighted in [23].

Therefore, the focus of this research is on mobile applications and devices that facilitate social interaction among

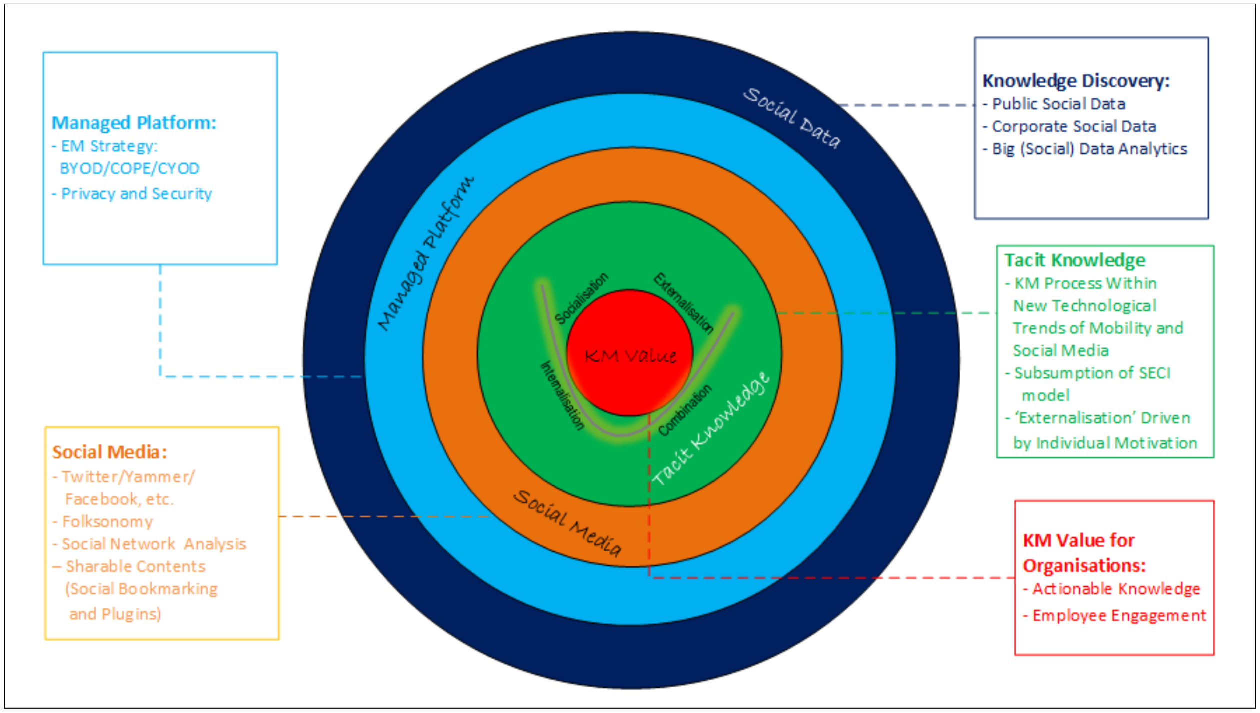

Figure 3: EMSoD - A Conceptual Social Framework for Corporate Knowledge Management

employees from which organizational knowledge could be gained. Such mobile devices as smart phones and tablets as well as the mobile applications like social media that they enable, which are in turn, enablers of social interaction within the organization.

KM based on the management and facilitation of these social interactions is potentially able to propel organization to strategic competitive advantage, especially in this era of knowledge economy where social media is playing a crucial role.

Technically, custom-made mobile devices for single applications like those used in the FEDEX and UPS examples can not be integrated with social interaction as the limitation of their design and capabilities precludes this. Therefore, employees cannot be expected to bring their own (BYOD), neither could they be expected to choose (CYOD) or personally enable (COPE) their own devices. Nonetheless, the newer technological trends of smart phones are already been used for the same functions, which means, delivery drivers can track and manage their delivery on their smart phones while also using the smart phones to interact with their colleagues on social media. They can, for example, tweet their locations or ask for direction and get immediate response from colleagues. On the same smart phone, they could make/receive calls to/from friends, family or colleagues or even interact with friends and family through social media on the smart phones. These are healthy for work life balances which results in a satisfied work force that is motivated to engage in social interaction and as such, knowledge sharing. This is altogether a function of the flexibility of the enterprise mobility management strategy adopted by the organization. If the organization's mobility strategy is aimed only at operational efficiency without the facilitation of social interaction, then the organization may not be able to reap the benefits in employee insights and knowledge for its strategic competitive advantage.

B. *Tacit Knowledge*

Inherent in humans is a *tacit power* by which all knowledge is discovered, and this propels an *active shaping of experience performed in the pursuit of knowledge* [12]. Our framework places more emphasis on the externalization of tacit knowledge, which, we believe, has become the dominant element of the widely known Nonaka's model of knowledge conversion (see Figure 4). This is due to the impact of the current trends of mobile devices and social media which allow an uninhibited externalisation of thoughts even at the spur of the moment [10] except where the inhibiting factor is the individual motivation.

1) 'Externalisation' Driven by Individual Motivation

The distinction between data and information is a given, from Computer Science and Information Systems perspectives. However, Information is often used interchangeably with Knowledge, albeit erroneously. [24] have gone a step further in attempting to create an understanding of data and information as necessary tools [or resources] for knowledge, discarding the notion that knowledge is data or information. [25, pp. 170-172], [26] and [27] all agree on a DIKW pyramid, which describes the configuration of data, information, knowledge and wisdom while [28] has attempts to highlight the important differences between Knowledge Management and Information Management. It is because of the explicit nature of information that it has often been used interchangeably with knowledge whereas, explicit knowledge is only one side of the coin to knowledge. The other side of the coin is tacit knowledge, which people have in their minds and are not represented in an explicit way [29] because it is highly personal and difficult to formalise [5, 478]. One distinguishing factor between Knowledge and Information is in the disposition of tacit knowledge through its conversion to explicit knowledge (externalisation) on the one hand, and the exchange of explicitly codified Knowledge on the other.

However, unlike the spiralling movement of tacit knowledge as described by the SECI model of [30] (see Figure 4), this framework considers the horizontal flow of tacit knowledge between individuals within an organization. This flow consists in each individuals 'externalising' their views, opinions, sentiments and know-hows, at the spur of the moment [10], as enabled by the affordances of social media and mobile devices like smart phones and are supported by the current social interactions that exist within the organization. Having established engagement as a measurable value for organizations, the measurement of engagement is hinged upon the analysis of the social network that serves as the platform for the social interactions that exist within the organization. The thesis in this work is in the potential for a vast amount of data being generated by this social interaction, and from which actionable knowledge of value for the organization can be discovered.

2) Subsumption of SECI Model

[31] categorises KM processes into knowledge learning and developing phases. The main task in the knowledge learning phase is to learn new knowledge and increase employees' tacit knowledge from other tacit knowledge *(Socialisation)* or explicit knowledge *(Internalisation)*. The main task in the knowledge developing phase is to develop new knowledge by transforming tacit knowledge into explicit knowledge *(Externalisation)* or by combining explicit knowledge with other explicit knowledge *(Combination)*. In as much as tacit knowledge remains the conduit that connects both phases, the main thrust of this framework is to determine how the KM process can add value to organizations by enhancing tacit to explicit knowledge conversion within the construct of new technological trends of social media and enterprise mobility. This implies that this study is mostly concerned with the impact of the new technological trends of social media and enterprise mobility in supporting the "externalisation" pane of SECI model. We believe that this is the first framework that subsumes an aspect of the SECI model into current technological circumstances. By the same token, this is the very first attempt at positioning an engaged workforce as the nucleus of an organizational knowledge creation process.

Moreover, [32] argues that socialisation results in what he calls organization defensive routines with which most individual employees behave consistently even as the individuals move in and out of the organization. He concludes therefore that *because the actions used to create or to trigger organizational defensive routines are used by most people, their use cannot be attributed primarily to individual psychological anxiety*. In as much as knowledge conversion occurs when individual employees cooperate voluntarily in the process based on their own intrinsic motivation [33], the organizational culture would determine how this cooperation would engender positive knowledge sharing experience [34]. In supporting the externalisation and combination

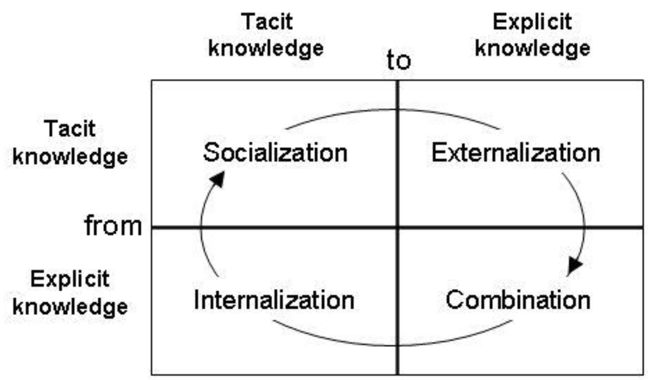

Figure 4: Nonaka's Model of Knowledge Conversion [30]

stages of SECI model, [29] observes the availability of knowledge acquisition methodologies for expert systems, discussion support systems or groupware in stimulating people's interaction. "However, these methods do not support the people's real-time discussion for knowledge acquisition", notes [29]. Mobile devices and social media trends enhance real-time discussion and as such require a new methodology in enabling them to support knowledge acquisition.

3) KM Process within New Trends

The tacit knowledge that exists within the socialisation pane of SECI model cannot be converted to explicit knowledge if it existed solely at this pane, and therefore would not be usable except in an apprenticeship or a mentoring situation [31]. As mentioned above, the main thrust of this framework is in how social media and enterprise mobility support employees in externalising their tacit knowledge in such a way that shared knowledge is created through a combination of the explicit knowledge thus created with other explicit knowledge.

This framework subsumes the entire SECI model into the externalisation of individuals' tacit knowledge which is enhanced by the Enterprise Mobility strategies of the organization coupled with the freedom of spontaneous expression offered by social media [10]. Social media tools like blogs and wikis, in addition to platforms like Twitter and Facebook, constitute the new technological trends with which KM must contend and subsist if it were to remain relevant [16, 17, 35, 36], ditto the perceived tension between KM and Social Media [4].

It is worth noting that existing methodologies in Computer Science do not sufficiently support the SECI model of knowledge conversion [29], especially in this new era in which IT has revolutionised the world [34]. Therefore, this framework is all about repositioning KM in a way that it delivers measurable value to organizations within these new trends.

C. Social Media

Social media are the collection of adaptable, scalable Web-based tools and technologies that facilitate the creation and sharing of user-generated contents [37, 38]. [39] describe them as " *browser or mobile-based applications that allow users to easily create, edit, access and link to content and/or to other* *individuals.*". "*Perhaps the best definition of social media, though, is content that has been created by its audience*", posits [40]. They include blogs, wikis and other social networking platforms like Facebook and Twitter [7, 16, 17, 35, 36], collaborative platforms like Myspace,Wikipedia, Ushahidi and Galaxy Zoo [2, 41]. Although, their origin can be traced back to the era of "*weblog*" which coincided with the creation of "*Open Diary*" which brought together online diary writers into one community in the sixties, they have become a popular trend that should be of interest to any company today [41]. Wikis are good for preserving the organization's memory while social networks like Facebook and micro-blogs like Twitter are helpful in expertise identification and location within the organization [42]. When it comes to including customer insight in an organization's social media strategies as suggested by [10], forums and message boards are probably the most common platform for questions and answers about products and brands [43], and can as well be included as a constituent source of external (public) social media that serve as external data source to the social data within the organization's managed platform.

1) Social Interactions on Social Media

Despite the media richness and "lifelike immersive world" that some social media platforms like Second Life provides, interactions on social media still cannot be as effective as face-to-face interactions [16], which has traditionally been the means of knowledge creation and transfer [44, pp. 7]. In fact, there has been a number of criticism with regards to the authenticity of the interaction and communication exchange over social media. One example pit forward by [45] is the story of a daughter who attempted suicide while in an actual state of distress whereas, she was at the same time using smiling emoticons and positive expressions to communicate a state of happiness to her mother. Perhaps this is why [46] believes that social media allows "*individuals to put on masks and hold up shields*". Yet the common denominator between all the Web-based social media tools and platforms is their ability to facilitate social interactions and conversations between people [17, 37, 39, 47, 48]. Moreover, it is not unusual for this online social interactions to extend even to face-face interaction, as it is found in [37] where an *Informant* comments that:

> " ...A lot of these people I have engaged in an online fashion have become part of our offline social functions and I formed real relationships with many. Hundreds of people: my network exploded it grew exponentially and it's through Twitter. It's through connecting with people. They find me. They reach out to me or I find them. I reach out to them. And we engage in ongoing conversations online, meeting up sometimes offline. These are real relationships."

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In understanding the nature of social interaction on social media, [48] have aptly and succinctly provided some operational definitions of the following terms, which are reproduced here, with kind permission from the publishers (Emerald Insights):

1) Sociability
   The ability to interact with others, or to socialize... Websites use features, design standards or technologies to encourage sociability. For example, an online dating website uses profiles to encourage users to interact with other users. Or, a blog 439 with user comments allows readers to respond to a topic and socialize with both the author and other readers.

2) Social network theory
   An interdisciplinary theoretical lens that emphasizes the relationships between actors (or users) within the network. The structure of the network is understood to be more important than the individual users... Social network theory, also called social network analysis (SNA), examines how the structure of a network affects users within the network.

3) Social networking sites
   Websites that encourage social interaction through profile-based user accounts. Social networking sites are commonly defined as Web 2.0..., meaning they mimic desktop applications. Popular social networking sites include Facebook and MySpace.

4) Social websites
   Websites and web technologies that promote socialisation online. This term encompasses social networking sites as well as more traditional social web technologies including bulletin boards, message boards or web-based chat rooms. This will be the primary term used in this work to describe social networking websites.

2) Folksonomy

Folksonomy is a term coined [49] as a linguistic contraction of *folk*, which informally refers to "people in general"; and *taxonomy* , which, as a formal system of structured classification of things and concepts, arose as a solution to the paramount problem in information management and retrieval: lack of organization [50]. Folksonomy is a practice in which individual users save/define Web contents as bookmarks/keyword in a social environment by attaching annotations in form of tags [51].

While taxonomy is a structured, top-down tagging system which the organization or a content creator imposed on the content for ease of retrieval and organization, folksonomy is an informal bottom-up approach to tagging where the user assigns tags to contents depending on the system. These tags are often used to create aggregated informal classifications (or, folksonomy), and as a navigational/discovery method.

3) Social Network Analysis

"*A social network is a social structure comprised of types of interdependency between nodes. Nodes are most commonly individuals or organizations. The configuration of individual nodes into a larger web of interdependency creates a social network*", explained [48], who also identify the two major types of interaction that exists within the social Web as:

1) People focused, which emphasise social interaction through user-driven personal content centred around a personal individual profile (e.g., Facebook, Twitter).

2) Activity focused, which emphasise social interaction through site-specific content centred around a thematic focus for a website with users providing their own contributions to that specific theme (e.g., Youtube and Flickr for video and photo themes, respectively).

According to the authors [48], this analysis of the social web examines people focused websites and their strategies to encourage sociability. It also entails studying the structure of the connections and relationships within a social network like Twitter with regards to the further depths and insights they provide towards the pieces of knowledge discovered from the network as suggested in [1].

D. Knowledge Discovery

Frawley et al. [52] describe *knowledge discovery* as a nontrivial extraction of implicit, previously unknown, and potentially useful information from data. The word, *'nontrivial'* in the definition implies that a significant organizational effort must come to bear on a knowledge discovery initiative. Knowledge discovery has been a cause of significant concern for corporate organizations since the 1980s when the total number of databases in the world was an estimated five million [52]. Nowadays, with the proliferation of mobile devices and the social interactions enabled by them, there has been an exponential increase in the amount of data being produced — an amount that dwarfs the figure mentioned above.

As a result, corporate organizations are increasingly exploring and exploiting insights from the big (social) data being generated, for their competitive advantage [1]. Not only is there a need for organizations to focus on knowledge discovery from their private/corporate data, there are potential knowledge and insights to be gained from public social data as this would help organizations know their industry trends, know their their environments and know their customers better [10].

Therefore, knowledge discovery efforts must be geared towards exploring and exploiting both public and private/corporate data, using big (social) data analytics techniques

E. KM Value

A couple of decades ago, "*discounted cash flow value*" may have been the best measure of value creation available [53]. Recently however, organizations have not only been regarding value in terms of the Returns on Investments, but they have also been giving considerations to intangible assets like organizational knowledge, patent and trademarks as measure of an organization's true value [54]. These indirect assets, according to [54], include employee morale, customer satisfaction and innovation; and, they are poised to "*transform the nature of business transactions by establishing the real value of enterprises for all stakeholders*".

Knowledge Managers and/or CIOs have often struggled to justify IT expenditure, especially, since when IT has been viewed from a cost centre perspective. This has often resulted in intangible field of practice like KM taking the hits from budget cuts as a result of a lack of measurable value [55]. However, since each process of Nonaka's SECI model (from *socialisation* through *internalisation*), "is positively associated with perceived knowledge satisfaction", [56] argue that organizations should focus more on perceived knowledge satisfaction rather than an objective measure of knowledge effectiveness. This is corroborated by "the Microsoft and Netscapes of the world..." which, according to [54, p. 6], show that, "even without a common yardstick for measuring Intellectual Capital, the recognition of its presence by informed observers will establish a value for a firm that dwarfs its balance sheet".

Moreover, with regards to value being defined as outcomes relative to cost, cost reduction without regard to the outcome achieved is dangerous and self-defeating, according to [57], who concludes that, outcomes, which are the numerator of the value equation, are inherently condition-specific and multidimensional. This position is strengthened by the NAO's definition of Value for Money (VFM): "*Good value for money is the optimal use of resources to achieve the intended outcomes*" [58]. What are these intended outcomes by which KM value can be measured and how can social media (the resources) be optimally used to achieve them? These are some of the issues encapsulated in the motivation for this research and the question this paper attempts to answer.

Based on the above premises, this paper identifies two intended outcomes from which knowledge satisfaction can be perceived, and by which we assert our measure of KM value to organizations: (i) the generation of *actionable knowledge* and, (ii) the facilitation of *employee engagement*.

Although many organizations have turned to storytelling and anecdotal success stories to show the value of their KM investments, there is an increasing need for businesses to show the business value of KM in terms of normalised quantitative measures in developing a case for Return on Investments [59]. This is what business managers and accountants, whose perception of realities is largely in terms of numbers, are looking for when they criticise KM for want of a measurable values. The *EMSoD* social framework proposed in this paper does not only deliver the KM value but also proffers solution for the measurement.

Meanwhile, "*Metrics fulfil the fundamental activities of measuring (evaluating how we are doing), educating (since what we measure is what is important; what we measure indicates how we intend to deliver value to our customers), and directing (potential problems are flagged by the size of the gaps between the metrics and the standard)*" [60]. It is worth noting that the topic of metrics is viewed differently from both Management and Academics, as Melnyk and others [60] observe:

> "The academic is more concerned with the validity and generalisability beyond the original context, of the results from such measurements that are defined, adapted and validated in addressing specific research questions. The manager, on the other hand, is more than willing to use a befitting measure if it can quickly provide useful information."

In view of this, we devised a simple measurement mechanism which, we believe, satisfies both academic and management concerns. This is denoted by the formula:

$$KMV = AK \times EW \tag{1}$$

where

$$KMV = KM\ Value,$$
$$AK = Actionable\ Knowledge$$
$$EW = Engaged\ Workforce.$$

Having laid out the *EMSoD* Framework, the next section proceeds with an overview of our work on *Knowledge Discovery from Social Media Data...* [1], with some additional insights that strengthen the work. This, we hope, would help the reader in making the connection between the background and our strong cases for *actionable knowledge* and *employee engagement* as measures of KM value, and the practical application of the above Formula (1) in measuring the value derived from KM through the *EMSoD* framework.

V. Knowledge Discovery from Social Media Data

In [1], we demonstrate the discovery of actionable knowledge from social media data with a case of Twitter data for small and medium-sized enterprises (SMEs). This is not only because SMEs are drivers of sustainable economic development [61], but also because their role within an Economy is so crucial that even the World Bank commits hugely to the development of the sector as a significant part of its efforts in promoting employment and economic growth [62].

Liaise Loddon is a medium-sized enterprise with about 220 employees, providing residential social care for adults with autism and learning disabilities in Hampshire, United Kingdom. As typical in this sector, operational procedures result in an enormous amount of documentation arising from daily diaries, incident/activity reports and several other reporting in compliance with regulatory requirements, analytical purposes and decision making. Although the company has recently deployed an enterprise mobility suite of mobile devices and applications to replace the existing paper-based documentation system, the research experiment explores how this enterprise mobility agenda could be hardened with knowledge sharing and knowledge extraction from the mass of social data freely available on Twitter, for example, in such a way as it supports the organization at the second level of organizational change, which highlights the people dimension of a socio-technical system [23, p.35-38].

As such, a total of $149,501$ tweets based on categorical keyword, *autism*, is harvested from Twitter streaming API. Using textual analysis technique, extraneous elements are filtered out in order to reduce the data, as it is in data mining where one solution to the challenges of handling vast volumes of data is to reduce the data for mining [63]. We narrowed the investigation down to only the tweets emanating from the United Kingdom and in English language, out of which we discovered 1473 tweets containing meaningful contents within our research context. The contents, as categorised in Table I, are outlined in Subsection V-A below.

A. An Outline of Knowledge Contents from the Case Data

Despite the data collection being based on domain-specific keywords of interest to the paper's case study, the research is an exploratory study in which there was not a preconceived idea of the insights/knowledge inherent in the data. Out of an enormous amount of data, only a handful may contain the valuable and actionable knowledge that propels an organization towards strategic competitive advantage [63, p.5]. As such, the bulk of the contents as seen in Table I, are largely re-tweets (RT) of the original messages and so, may be regarded as extraneous amplification of the original tweets. Therefore, this section describes the categories observed in the data and the next section follows with a discussion on the value and actionability of the knowledge so discovered:

Table I: CONTENT CLASSIFICATION OF TWEET DATA

Contents	***No. of Tweets (Including RTs)***
Impact of Technology on Disability	15
Information Gathering	10
Political Opinions (#votecameronout)	132
Social Welfare Benefits	327
Living with Autism	989
Total Tweets	**1473**

1) Impact of Technology on Disability

> "*RT @BILD_tweets: Helping to unlock the secrets of autism - a project using innovative technology aims to change how we address autism http:...*"

The above tweet provides an insight into a project using innovative technology to change how we address *autism*. As this paper's case study organization is in the business of autism support and also currently implementing mobile technologies to enhance its operational performance, it is worth exploring this piece of insight further.

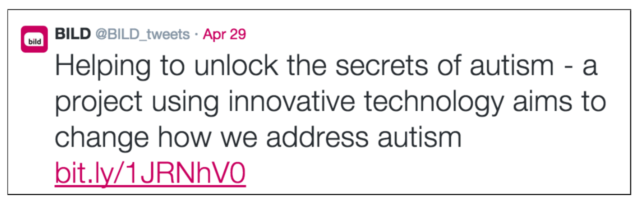
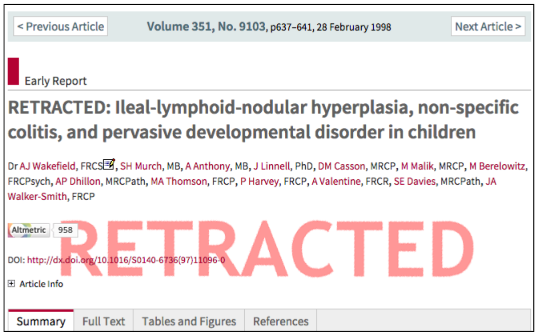


Figure 5: Original Tweet with Link to Project on Innovative Technology

Although the link to the actual URL of the story about the project is missing from the tweet, we can easily follow up with the original source of the tweet, as the above is a RT (Re-Tweet) of @BILD_tweets, which is the Twitter handle for BILD (British Institute of Learning Disabilities). BILD actually tweeted that piece of content on the 29th of April, which is a day before our data capture began, as can be seen in Figure 5. This explains why the original tweet was not captured in our twitter streaming data capture of 30th April to 6th May. From this original tweet, we have been able to extract the URL link (bit.ly/1JRNhV0) to the story about the project on innovative technology. This is about the National Autism Project, which "aims to create a more strategic approach to addressing the challenges of the condition". This project highlights the impact of iPads, picture dictionaries and interactive schedules on the improvements of communication and vocabulary of autistic people. Strategic competitive advantage requires an alignment/tagging along with this project. Below are samples of other tweets related to this content of Technology's impact


< Previous Article Volume 351, No. 9103, p637–641, 28 February 1998 Next Article >

Early Report

RETRACTED: Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children

Dr AJ Wakefield, FRCS, SH Murch, MB, A Anthony, MB, J Linnell, PhD, DM Casson, MRCP, M Malik, MRCP, M Berelowitz, FRCPsych, AP Dhillon, MRCPath, MA Thomson, FRCP, P Harvey, FRCP, A Valentine, FRCR, SE Davies, MRCPath, JA Walker-Smith, FRCP

Altmetric 958

RETRACTED

DOI: http://dx.doi.org/10.1016/S0140-6736(97)11096-0

Article Info

Summary | Full Text | Tables and Figures | References

Figure 6: Retracted Study Linking Vaccine to Autism

on disability while its pertinence, as an actionable piece of knowledge, is discussed further in Section VI. Meanwhile, we have derived further insights from Twitter data, that helps in strengthening the position of this knowledge item (Impact of Technology on Disability). This is discussed in Section V-B

> "*tech reducing the impact of disability - or are the latest gadgets too pricey? Watch @SkyNewsSwipe at 2130 http://t.co/iHtX1spOqQ*"

> "*Technology limits impact of disability but is it affordable? @TwitterUser_GT http://t.co/Az3nJejO32*"

2) Information Gathering

Below is the first tweet about vaccines causing autism in this category, which is a request for information.

> "*@TwitterUser @BBCNewsUS @BBCWorld Please direct me to this research, the thing about vaccines causing autism was admitted to be a fraud.*"

Just as an enterprise micro-blogging tool could be used within the organizational social network, public micro-blogging tools like Twitter provide the platform to quickly seek information, knowledge and/or ideas from a heterogeneous audience defying the constraints of space, time and location. Thus, the above tweet was almost instantly replied to by the one below:

> "*@TwitterUser Here's the original study that said that vaccines cause autism, from a respected, peer-reviewed journal: http://t.co/cmVVKpLQgh*"

Even though the original study is from a 'respected, peer-reviewed journal', as claimed by the sender of the above tweet, we know from the link provided that the publication of the research has been retracted as shown in Figure 6. The ability for anyone to search, gather and distribute information seamlessly in this manner provides an interesting dimension of social media as "relatively inexpensive and widely accessible electronic tools that enable anyone to publish and access information..."[64].

Meanwhile, the following two tweets provide link to further information that could help drive home the knowledge that the research study in question has actually been rebuffed:

> "*RT @TwitterUser: @SB277FF vaccines do not cause autism. They don't. But if they did, what would you prefer? Autism or incurable smallpox/po*"

> "*RT @BILD_tweets: There is 'no link between MMR and autism', major study concludes. http://t.co/Re9L8fPfGV via the @guardian #autism*"

In as much as Twitter allows for an almost spontaneous expression of opinions by anyone, it offers a good platform for healthy debate on topical issues from which knowledge could be mined, as exemplified by the question of preference between autism and incurable smallpox posed by one of the tweets above.

Moreover, the following tweet with a URL link to *Learning Disability Census* is an example in knowledge discovery (of an official census and regional data on Learning Disabilities), which when actioned in conjunction with the enterprise resource planning, could have an impact on the company's strategic planning:

> "*RT @dmarsden49: Learning disability census with regional stats is out. Check http://t.co/Ja3tk7ZRDZ*"

3) Political Opinions (#votecameronout)

The role of public opinion cannot be over-emphasised insofar as it shapes and is shaped by government policies. A recent and relevant example is the UK tax credits row [65], which has seen the planned tax credit cuts, at the time of writing this report, suspended by government because the scheme proved unpopular to the public and thus defeated in the House of Commons. Social media, especially Twitter, provides a means of capturing and measuring the sentiments and opinions of the electorate.

It is therefore, no coincidence that political opinions that have been expressed, are included in the Twitter data gathered over *autism* and *disability* keywords:

> "*#votecameronout Because he wants to get rid of Human Rights Act which will affect: Maternity Rights; Workers rights; Disability Rights*"

> "*For the harassment of people struggling on sick & disability benefits... #VoteCameronOut*"

> "*5 more years of the Tories we will lose Social Care, NHS, Human Rights, Workers Rights, Unions, Disability support. #VoteCameronOut*"

Using the hashtag #votecameronout in the run up to the UK General Elections of 2015, the above tweets represent an active campaign against the then incumbent Tory-led government in which David Cameron is Prime Minister. It is interesting to note that the bulk (129) of the political tweets in this experiment's Twitter data are a proliferated re-tweets (RT) of the above 3 original tweets. The correlation between public sentiments on social media and elections results and/or on government policies, is another growing area of interest in social media research. In politics meanwhile, it is not uncommon for opponents to whip up public sentiments by whatever means possible. Social Welfare issues are quintessentially core, and often politicised, concerns in the UK. A parallel category of tweets in this work is that of social welfare benefits, which is described in the next section. Although this research's data-set is based, as stated earlier, on categorical keywords that define

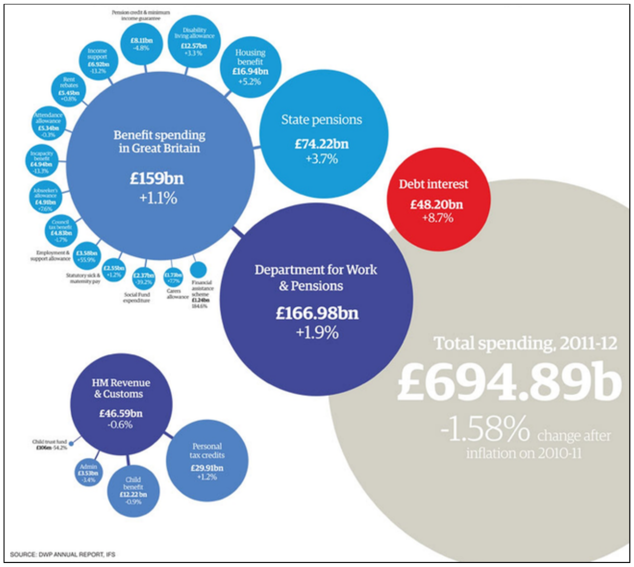


Figure 7: Public Spending on Benefits in the UK

the business of the case study organization, the infiltrated political opinions cannot be ignored in as much as these are public opinions that shape political trends which potentially impacts on businesses in terms of government policies. Akin to this is the category on social welfare benefits, described in the next section.

> "*Uproar at thought of @Conservatives cutting child benefits if elected - I wish there was same media outrage over disability cuts #GE2015*"

4) Social Welfare Benefits

Social Welfare simply implies the "Well being of the entire society" [66], which promotes inclusivity for the disabled, the sick, the elderly/pensioner, the unemployed and even the low income earners. As this is the hallmark of an egalitarian society, the UK government renders financial assistance to these categories of people in form of a range of Social Welfare Benefit payments. Figure 7 provides an insight into public spending on social welfare benefits in the UK [67]. As indicated in the preceding section, social welfare issues affect the fabrics of the society and any proposed significant cut in social welfare benefits is a natural invitation for public dissent. This category of tweets from this work represents genuine sentiments and opinion of those expressing them, without political motivations like the preceding category:

> "*@George_Osborne If only I could live until pensionable age. You've reduced my disability benefit well below living standards!*"

> "*39 yo woman killed herself after Department Work and Pensions threats to cut off disability benefits http://t.co/TkVQF2UYki...*"

Again, the above are a few samples of sentiments and opinions about *Child Benefits* and *Disability Benefits*, which provide an initial understanding to the unassuming, that social welfare benefits are not a one-size-fits-all affair but are multifarious (see Figure 7), with some being exclusively non-means tested (e.g, Child Benefit). These tweets provide some insights into public sentiments towards government policies. Since any of such social welfare benefit cuts would directly and/or indirectly impact the service users and providers of social care, it can be inferred that the case study organization would also share these public sentiments.

5) Living with Autism

Autism is defined as a *life-long neurodevelopmental condition interfering with the person's ability to communicate and relate to others* [68]. How can this definition be juxtaposed with one of the myths surrounding autism [69, item 8] that *autistic people do not interact*? This myth is however, dispelled by the tweet below, which is a re-tweet of an original tweet by an actual autistic blogger who attempts to use his blog posts to connect with the general public:

> "*@matt_diangelo RT? It would be truly amazing if u could view my blog about living with Autism&OCD. Would mean a lot- http://t.co/JCGBBZz8fJ*"

This category constitutes the bulk of the Twitter data for this work as it contains multiple unique re-tweet of the same tweet — over 900 times (see Table I). This is an indication of the public interest/curiosity and positive sentiment towards the subject of autism in general, and towards the autistic blogger in particular. Despite the National Health Service (NHS)'s attempts at educating the general public by diffusing some of the myth surrounding the subject of *Autism* [70], among several *Autism Awareness* initiatives, the story of autism as told by an autistic person appears to garner more public support and understanding. Measuring public opinion and sentiments through social media impact, reach and networks is another interesting research area in social media research towards which this work can potentially be extended.

B. Further Insights from Twitter Data

As it has been over one year since we gathered the data used for our previous study in [1] using the categorical keyword of *autism*, we decided to do a quick check on the current public conversation on the subject. We gathered 6118 tweets mentioning the categorical search keyword of *autism* for just one day on the 5th of August, 2016. Of this, $3,290$ are original posts by Twitter users while 2828 are a Retweets of the original posts while the rest are *replies-to*. Although the day opens with a tweet containing a pleasant human story about the cure of autism (Figure 8), we found it pleasantly surprising that some top issues as discovered from our data of over a year ago, are still currently leading the conversations on the subject, as shown in Figure 9. Considering (A) and (B) from Figure 9, the following tweet content, as tweeted by the CNN, led the conversation at different times of the day, with 111 and 93 reactions, respectively:

> "How pokemon go helps kids with autism https://t.co/DZatqTX4sc #PokemonGo"

It is worth recalling that the theme of the *impact of technology on disability*, which was the most pertinent knowledge

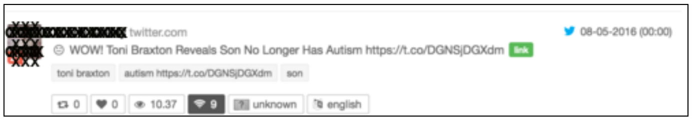


Figure 8: Tweet about Cure for Autism

item from our previous data, did inform a significant corporate decision by the case study organization, as asserted in [1]. The above tweet on how the new *Pokemon Go* game helps autistic kids, is an indication of the fact that the theme of the impact of technology on disability, dominates the conversations on the subject of autism for the second year running. Although, not directly related to our *actionable knowledge* gains, another issue that gained prominence in our previous data was the debate over the causal relationship between vaccines and autism. The same debate still reappears prominently in the recent newer data on the subject of autism as shown in Figure 9 (C). The next section proceeds with a discussion on *actionable knowledge* and presents our proposed mechanism for placing a weighted measurement for KM value.

VI. Actionable Knowledge

Everyone agrees that Knowledge entails true belief [71], but this is not always the case. Using the man, the job and the coin analogy, Gettier [72] argues that it is possible for a person to be justified in believing a proposition that is in fact, false. This brings about the question of what actually counts as knowledge. In light of our data, we shall examine this question in our discussion on *actionable knowledge*, next.

A. Discussion on Actionable Knowledge

According to [73], propositions that are actionable are those that actors can use to implement effectively their intentions. A case in point is the enterprise mobility agenda of the case study organization as presented in Section V. The outcomes from an organization's KM efforts cannot adequately be measured from the report card perspective and indicator systems used in schools, for example. These systems, according to [74], contribute far less than they could to school improvement. Posner [74] highlights the following as the reasons for this assertion:

1) Their purposes and intended audiences are often diffuse or ill-defined.
2) They tend to focus too much on ranking and not enough on exemplary practices and models for action.
3) Many data sets are overly tied to consumer choice and not enough to citizen engagement.
4) Despite vast improvements, research remains inaccessible to many people, bringing knowledge online but not infusing it into capitols, classrooms and kitchen-table problem-solving

[74] therefore, suggests that information must be crafted around organising and action, citing [75], who says, "Actionable Knowledge is not only relevant to the world of practice, it is the knowledge that people use to create that world". The action triggered by knowledge is of the essence in determining the value that KM delivers to an organization. In fact, the real essence of knowledge is its actionability, especially when it contributes to the advancement of a proposed undertaking [3].

Each of the knowledge items discovered from the tweet data, as highlighted in Section V-A, is capable of providing significant insights that informs decision making, which impacts company's proposed undertakings at one point or the other. However, as stated in [1], the first item, *Impact of Technology on Disability (No.1)*, is more pertinent to the enterprise mobility agenda by which the company deploys mobile application and devices to its operations. For example, one of the shortened URLs contained in one of the tweets (http://t.co/Az3nJejO32), leads to a Sky News supplement on *How Tech is Helping with Struggle of Disability*.

We assert therefore that, to aspire to a leadership position in the health and social care sector, the case study organization cannot afford to be oblivious to such reports as this, which could potentially shape the industry trends and direction. This knowledge, coupled with the insights gained from the use of iPads and pictorial dictionary mentioned in the *Project on Innovative Technology*, resulted in an official resolution by the company to extend the use of mobile devices to its service users as well, and not only to help staff in operational performances. It is worth noting that, although the piece of actionable knowledge regarding the impact of technology on disability was on the news prior to the extraction of data for that research, it was neither known nor acted upon by the company until the above decision was driven through a presentation made by the authors of this paper.

Meanwhile, we also discovered further insights from recent data, as discussed in Section V-B, which indicates that the theme of the *impact of technology on autism* is still leading the conversations on *autism* for the second year running. We had earlier alluded to the criticism of Knowledge Management as a field of practice, in spite of the gains — albeit intangible — from Knowledge Management and knowledge discovery efforts. This is due, in part, to the lack of a measurable value of those gains. With Equation (1) in Section IV-E, this paper proposes a measurement mechanism for KM Value delivered by our *EMSoD* framework, which is the main objective of this paper. The next section proceeds with a measurement mechanism for *actionable knowledge*.

B. Value Measurement Mechanism for actionable knowledge (AK)

The main objective of this paper is the delivery of KM value to corporate organizations which, we believe, our ***EMSoD*** framework helps to deliver. We had earlier identified *actionable knowledge* as a measure of KM value, in which actionable knowledge is denoted as *AK* for measurement purposes (see Equation 1 in Section IV-E).

To find the numerical value of (AK) in the equation $(KMV = AK \times EW)$, we devise a simple measurement mechanism as denoted in Equation (2):

$$\frac{\sum^{n} Weight_n}{n \times MaxWeight} \tag{2}$$

where

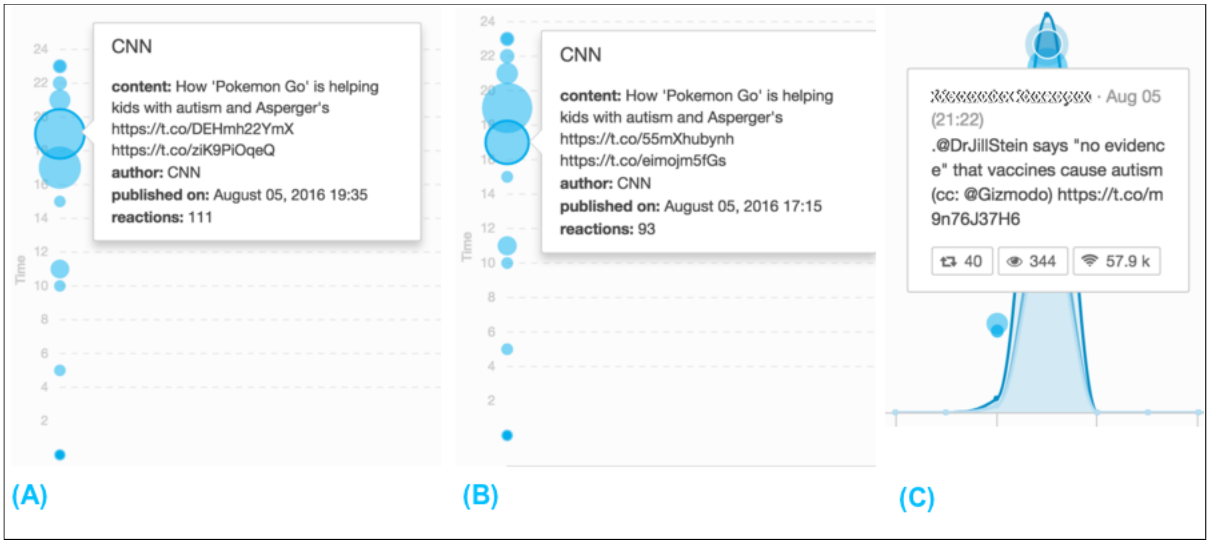


Figure 9: Top Issues from Newer Twitter Data

Table II: KNOWLEDGE CONTENTS AND THEIR WEIGHTS

Content	*Weight*
Impact of Technology on Disability	5
Information Gathering	2
Political Opinions (#votecameronout)	2
Social Welfare Benefits	3
Living with Autism	2

n = total content items
$MaxWeight$ = maximum assignable weight

As an example, we consider our knowledge content items from our previous work as outlined in Subsection V-A and displayed in Table I. The total content items (n) is 5 and each one of them is given a weight of 2, 3 or 5, which represent low, medium or high value, respectively. Please note that the weights have nothing to do with the *No. of Tweets* as displayed in the second column of Table I. However, the weights represent the pertinence of the knowledge item to the matter or issue at hand within the organization, where the maximum weight (MaxWeight) of 5 represents a high pertinence, 3 represents medium pertinence and the weight of 2 represents a low pertinence. High to low pertinence is directly mappable to high to low value, respectively. We acknowledge the probability and freedom for subjectivity in assigning these weights. However, in order to reduce the level of subjectivity, we recommend for this measurement activity to be carried out only after the KM activity/event in question has been concluded. In our example, the knowledge discovery from social media data has been completed and we know which of the knowledge items has had a high impact on management's decision making for us to assign a high weight of 5; and, medium weight of 3 and low weight of 2 to items we consider of medium and low values, respectively, as shown in Table II.

The item with the maximum weight (MaxWeight) of 5, *Impact of Technology on Disability*, is of a high pertinence to the enterprise mobility agenda by which the company deploys mobile application and devices to its operations.

Therefore, going by Equation (2), the maximum value is 25, being a product of the total number of content items (n, which in this case, is 5) and the maximum weight (5). The total number of content items (n) could be any whole number, which allows for AK to be representative of every knowledge content item or categories that is considered relevant for inclusion in the value measurement. Also, with the numerator being a sum of all the $Weights_n$, the value of AK from Equation (1) is given thus:

$$KMV = 0.56 \times EW \tag{3}$$

A Note on Weights and Values Assignment

One may ask why the *Impact of Technology on Disability* receives the maximum weight of 5? As stated earlier, it is because of being of more pertinence to the enterprise mobility agenda by which the company deploys mobile application and devices to its operations? For example, one of the shortened URLs from the tweets (http://t.co/Az3nJejO32) leads to a Sky News supplement on *'How Tech is Helping with Struggle of Disability'*. To aspire to a leadership position in the health and social care sector, the case study organization cannot afford to be oblivious to such reports as this, which could potentially shape the industry trends and direction. This knowledge, coupled with the insights gained from the use of iPads and pictorial dictionary mentioned in the *'Project on Innovative Technology'* resulted in an official resolution by the company to extend the use of mobile devices to its service users as well, and not only to help staff in operational performances. It is worth noting that, although the piece of actionable knowledge regarding the impact of technology on disability was on the news prior to the extraction of data for that research work, it was neither known nor acted upon by the company until the above decision was driven through a presentation made by the authors of this paper.

The *EMSoD* framework presented in this paper is predicated upon the capability of social media in delivering actionable knowledge to corporate organizations. We have thus, been able to place a measurable value on actionable knowledge (*AK*). This is ordinarily sufficient as a measure of KM value derived from such insights from social media data. However, our framework — and the KM value it delivers to corporate organizations — is further strengthened by an additional measure of the KM value, which is *employee engagement*, denoted as *EW* (Engaged Workforce) in Equation (1). The next section discusses *employee engagement* in the light of the social network that exists within the organization, the impact of the structure of the network on employee engagement and knowledge sharing as well as a measurement mechanism for the KM value of *employee engagement*.

VII. Employee engagement

It is worth reiterating our assertion of *employee engagement* as a measure of KM value for business, given that "the level of employee engagement is one of the most important indicators of the likelihood of an organization succeeding financially and delivering to its vision and mission statements" [76]. Also, research has shown that, having a highly engaged workforce not only maximises a companys investment in human capital and improves productivity, but it can also significantly reduce costs (such as turnover) that directly impacts the bottom line [77].

Thus, the organization's Enterprise Mobility Management (see *Managed Platform* in Section IV-A) defines the organizational boundary within which employees' contributions are gathered as a measure of their engagement and as a reference point for the organizations Social Network Analysis, which can serve as knowledge input to the organizations Intellectual capital.

Based on the above premises, this work posits the prevalence of knowledge creation and knowledge sharing culture in an organization with a truly engaged workforce. How then, does the social network facilitate employee engagement? How does the structure of the connections and relationships within a social network provide further depth and insights to knowledge discovered from such networks [1]? We explore this question further, first in the light of the power of social networks and an anatomy of the social network of an engaged workforce.

A. Power to Know, Power to Tell

"*I shall reconsider human knowledge by starting from the fact that we can know more than we can tell*", writes Michael Polanyi [12], whose writings and philosophical thoughts provide an impetuous theoretical background for many scholars and practitioners of Knowledge Management. This lends credence to Turban and others [11, p.478]' idea of the difficulty in formalising tacit knowledge. Embroiled in information overload due to a deluge of data and exponential growth in information systems, technologies and infrastructures, the ability to know or tell as much as we know is limited by our human cognitive capabilities. However, the same information systems and technologies, which were not in existence during the times of Polanyi, allow us to offload our cognition on to them [78]. Such technologies (e.g., the Web) are enablers of online social networks, which does not only allow us to offload our cognition onto them but also allow us to benefit from the problem-solving and decision-making situations offered through the "wisdom of the crowd" [79] amazed through the cognition offloaded by several other individuals.

With several actors within a social network offloading their cognition onto the social network through explicit expression [10], a wealth of tacit knowledge is inadvertently built up, albeit explicitly converted. This wealth of knowledge is, of course, too massive for an individual to tell. It might even be impossible for one individual to be expected to know of the existence and/or extent of such knowledge, due in part, to the limitations in human cognitive capabilities, as mentioned earlier. It must be noted however, that this is only a limitation applicable to a single individual, but not to a corporate organization. With the affordances of social network analysis (SNA), a corporate organization is empowered to know more about, and exploit, the wealth of knowledge that is built up within its enterprise social network. The organization can tell, through visualisation and network analysis, the structure of the social network and its impact on *employee engagement* that propels externalisation of tacit knowledge. In essence, we can assume that, if Polanyi [12] were to reconsider human knowledge within the context of social networking trends today, he would probably say that, *"we can tell as much as we can know."*

B. Social Network Analysis

Social Network Analysis (SNA) is described as a detailed examination of the structure of a network and its effect on users (actors) within the network, wherein the structure of the network is understood to be more important than the individual users [48]. A core component of our *EMSoD* framework is Social Media (see Section IV-C), which serve as platforms for social interactions on the Web. With peculiar example of Twitter, these social interactions are explained by the relationship types of *'mentions', 'replies to'* and just, *'tweets'*. A *mentions* relationship exist when a message on Twitter *tweet* mentions another user (@Username) while a *replies to* relationship exist when a *tweet* is in reply to another user's tweet by preceding the *tweet* with the other user's Twitter ID (@Username). When a tweet is neither a reply to - or contain a mention of - another Twitter user, the tweet creates a relationship type of *tweet*, which exist as a self loop and is indicated on a network visualisation as a node with an arrow that projects and returns unto itself. These relationships develop into a network of connections.

In SNA, the connections between people are considered as the units of analysis that reveal the flow of information and how these connections define the structure of the network, which also refers to the presence of regular patterns in relationship [80]. Gaining insights towards the understanding of the components and structure of a social network requires a vocabulary and techniques provided by Social Network Analysis (SNA) and Visualisation [81]. This vocabulary and techniques are described in our examination of two different kinds of networks identified by Rossi and Magnani [82] as, (i) the *topical network*, which is made up of relationships created through tweets/activities that are aggregated over a topic or the *#hashtag* and, (ii) the *Twitter network*, which is made up of all the relationships between the users (followers and friends). We believe that the relationship between the Twitter *[structural]* network and the topical network can be likened to that of the

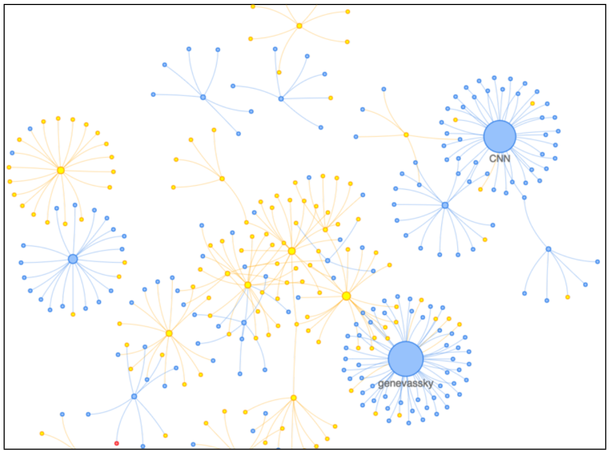


Figure 10: Influencers Engagement Network Graph

physical and logical topologies of a communications network infrastructure.

C. Understanding the Topical Network

A topical network is created when users are connected by common topical issues, where individuals save/define Web contents as bookmarks/keyword in a social environment by attaching annotations in form of tags [51], normally preceded by the hash symbol on most keyboards (#). The hashtag can be said to be the democratic manifestation of taxonomic principles in the social media era (see Section IV-C). Trant (2009) [83] highlights the description of such *tags* as publicly shared user generated keywords, which have been suggested for use as a trivial mechanism for further improving the description of online information resources and their access through broader indexing.

An example of the topical network is shown in the Influencers Engagement Network Graph presented in Figure 10. This network has been aggregated over the search keyword and hashtag of *#autism*, as found in our recent data on the subject (see Section V-B). Both this *topical network* study and the study that results in further insights on our previous study from recent data, were performed on University's account on the Pulsal Platform — an audience intelligence analytic platform for social media.

D. Limitation of the Topical Network

The *EMSoD* social framework proposed in this research operates within a *managed platform* (Section IV-A), which defines the organizational boundary. Although the hashtag phenomenon has been successful in aggregating online topical discussions without boundaries, the relationships created over mutual hash-tagged conversation is ephemeral [82], and so is the network created. Unless the hashtag can be tamed, its use on a public Twitter account can be so widespread that it compromises the need, if there were, to keep the conversations within the organizational boundary. Even with the use of enterprise Twitter's alternative like *Yammer*, aggregating events and conversation over the hashtag cannot but include *Yammer-wide* conversations and events from outside the organizational boundary. Yet, it is essential

For example, when one takes a look at the topical network created over our recent data on the subject of *autism* in Figure 10. The nodes are not defined within a single geographical boundary. The nodes in yellow colour represent those from the United Kingdom. The location information for the nodes in blue is unavailable. This means that users from various countries other than the UK are aggregated over this topic. In fact, the two most engaged influencers's networks (CNN and genevassky) are not from the UK. This may be good in that it provides further reach and depth around the topic but not for classified organizational conversation that needs to be kept within the boundary of the organization's network, assuming the UK was a corporate entity in the business sense.

Specifying network boundaries in terms of hashtag or keywords that connect people together in this manner is more akin to the *normalist approach* of specifying a network, which is based on the theoritical concerns of the researcher [80], whereas the actors may not even know one another. Contrarily, Wasserman and Faust [80] also describe a second way of specifying network boundaries, the *realist approach*, wherein the actors know one another, since membership of such network is as perceived and acknowledged by members themselves. In essence, employees would readily acknowledge and engage with fellow colleagues as members of the same network. The *realist approach* aligns with the *Twitter* network as identified by Rossi and Magnani [82]. The next section attempts to create an understanding of the *Twitter* network.

E. Understanding the Twitter Network

Considering its perceived ease of use and a broad coverage of SNA metrics and visualisation features [84], we used NodeXL - a network analysis and visualisation package designed for the analysis of online social media on Microsoft Excel [85] - to examine the egocentric network [86] of relationships that develop over a one month period from 26/07/2016 to 25/08/2016. As stated earlier, relationships emerge when a user (the source) *mentions* or *replies to* another user (the destination) in their tweet. For example, the following tweet of 29/07/2016, in which @unisouthampton *mentions* @nature — the Twitter handle for the International Weekly Journal of Science — creates a relationship (*mentions*) between the two entities:

> "Our #research places us top 50 globally and 4th in the UK, in @nature Index Rising Stars: https://t.co/XwXKR9N8Az https://t.co/VGQDxPE74y"

A relationship also emerges when a tweet is self sufficient without *mentioning* or *replying to* any other tweet by including or preceding with another Twitter @username, respectively. These are regarded as *self loop* and is indicated in Figure 11 by the red arrow proceeding and returning to the source (@unisouthampton). As can be expected that a user could tweet without having to mention or reply to any other user, there are 68 such self loops, 102 unique Edges and 129 Vertices (Nodes) within the network so generated (see Table III). The connections made through the *'replies to'* relationships are represented with Edges (connections lines) of 60% opacity than the connections made through the *mentions* relationship, which are represented by Edges of 20% opacity.

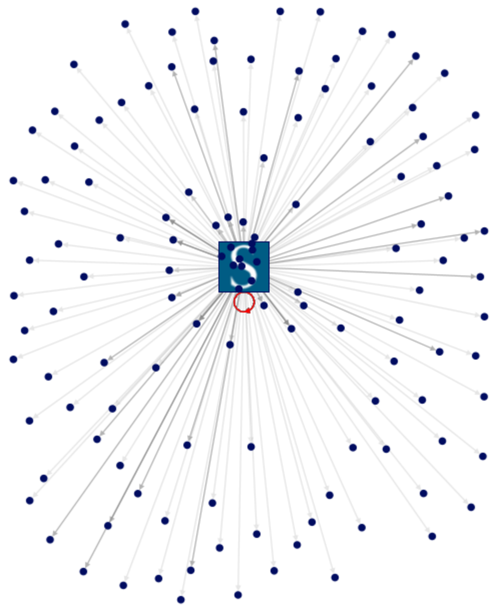


Figure 11: A Directed Network Graph of @unisouthampton

Meanwhile, the network graph in Figure 11 is a *directed graph*, or *digraph* for short, which represents directional relations comprised of a set of nodes representing the actors in the network and a set of arcs [lines] directed between pairs of nodes representing directed ties between nodes [80]. A social network graph is formally represented by a graph G = (V, E), where V is the set of nodes (vertices) and E is the set of edges (ties) [87]. However, a cursory look at the network graph in Figure 11 would reveal that the @unisouthampton account, represented with the large icon of the University of Southampton logo, has only an *Out-Degree* connection with up to the 129 nodes and 1 *In-Degree* connection, which is the self loop unto itself. The *directed* relations through In- and Out-Degree connections define the asymmetric relationship model of following in Twitter, which allows one to keep up with the tweets of any other user without the need for the other user to reciprocate [88].

Table III: GRAPH METRICS FOR FIGURE 11

Vertices	129
Unique Edges	102
Edges With Duplicates	163
Total Edges	265
Self Loops	68

According to [80], "the concept of a network emphasises the fact that each individual has ties to other individuals, each of whom in turn is tied to a few, some or many others. The phrase, "social network" refers to the set of actors and the ties among them. The network analyst would seek to model these relationships to depict the structure of a group. One could then study the impact of this structure on the functioning of the group and/or the influence of this structure on individuals within the group".

However, the network as it is presented in Figure 11 is not an ideal network that encourages knowledge sharing and engagement among the actors. The three relationships that develop were initiated by @unisouthampton's tweets in which other users were *mentioned* or *replied to* or in which the tweets were sent wholly to create a *tweet* relationship. Querying NodeXL with only the Twitter ID of a corporate or individual's Twitter account, as we did with @unisouthampton, would only result in a visualisation of the list of connections, as Figure 11 reveals. Moreover, with over 40,000 nodes, a meaningful visible visualisation of a network of such magnitude as the @unisouthampton's can be difficult because of the inherent complexity of the relationships and limited screen space [89]. According to Wasserman and Faust [80], "The restriction to a finite set or sets of actors is an analytic requirement."

Therefore, we identified 93 Twitter users (Vertices or Nodes) within the University of Southampton and examine the network of connections that evolves around them. Table IV presents the overall graph metrics.

Table IV: GRAPH METRICS FOR THE NETWORK GRAPH OF 93 VERTICES

Graph Metric	Value		Graph Metric	Value
Graph Type	Directed		Connected Components	9
Vertices	93		Single-Vertex Connected Components	8
Unique Edges	303		Maximum Vertices in a Connected Component	85
Edges with Duplicates	15925		Maximum Edges in a Connected Component	15758
Total Edges	16228		Maximum,Geodesic Distance (Diameter)	3
Self-Loops	13628		Average Geodesic Distance	1.962102
Reciprocated Vertex Pair Ratio	0.221206581		Graph,Density	0.078073866
Reciprocated Edge Ratio	0.362275449		NodeXL Version	1.0.1.355

1) Grouping the Network on the Basis of Node Importance

Various metrics (Degree centrality, eigenvector centrality, pagerank, etc) capture various ways in which each individual node (user) acts as a centre of attraction through which knowledge and information propagates within the network. Sorting by Betweenness Centrality for example, sorts people who have the quality of most broadly connecting across the network to the top while Clustering coefficient measures how closely connected each users connections connected to one another [90]. As this work is focused on measuring and seeking to facilitate employee engagement, we have used Betweeness Centrality (BC) as our measure of ranking for node importance based on the potential of such central points for binding the network together by coordinating the activities of other points, albeit, they may be viewed as structurally central to the extent that they stand between others and can therefore facilitate, impede or bias the transmission of messages [91]. Moreover, measuring proximities can help to characterise the global structure of a network by showing how closely coupled it is [92]

Table V: Groups of Vertices with Metrics

Group	Vertices	Unique Edges	Edges with Duplicates	Total Edges	Self Loops	MAX. Geodesic Distance	AVG. Geodesic Distance	Graph Density
G1	41	90	7415	7505	6972	4	2.083	0.115
G2	21	1	2112	2113	2113	0	0.000	0.000
G3	19	2	2759	2761	2751	1	0.240	0.012
G4	12	21	2151	2172	1792	2	1.194	0.462

Accordingly, the 93 nodes (users, also referred to as *vertices*) in the network are ranked and grouped on the basis of their Betweeness Centrality, with each group disc sized according to the number of nodes that make up the range of measures for the group, as visualised in Figure 12 and the group metrics in Table V.

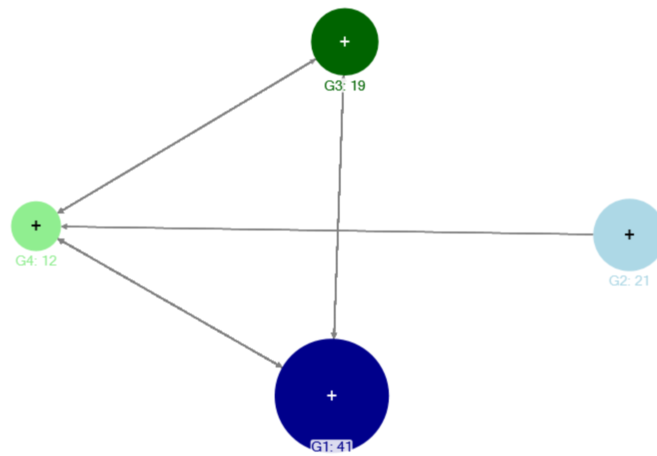


Figure 12: Network graph of 93 Vertices Grouped According to Betweenness Centrality

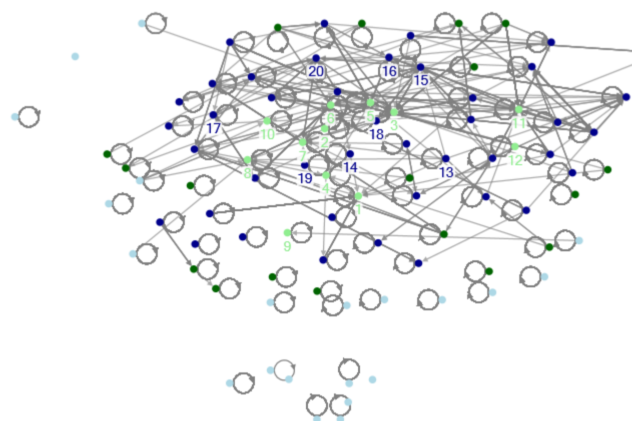


Figure 13: Expanded Group of Nodes According to Betweeness Centrality

2) Decomposing the Network Group of 93 Nodes

The smallest group in the network graph presented in Figure 12 (Light Green, G4:12) is a group of 12 nodes with the highest Betweeness Centrality ranging from 115.194 to 2494.640 (see Table VI), although the node with the highest Betweeness Centrality (2494.640) is @unisouthampton, and understandably with over 40,000 followers compared to only 558 followers of the next highest Betweeness Centrality node, @sotonwsi (at BC score of 522.543), and 2390 followers for @lescarr (with a betweeness centrality score of 425.512), in that order.

The largest group (Dark Blue, $G1 : 41$) is comprised of 41 nodes (vertices) with the second highest Betweeness Centrality ranging from 11.408 to 99.715, with the highest being @garethpbeeston (99.715), @lisaharris (94.079) and @mark_weal (93.573) in that order. Group 3 (Dark Green, G3:19) is composed of nodes with the third highest betweeness centrality ranging from 1.067 to 8.627.

Group 4, 3 and 1 are subgroups of this directed graph, as demonstrated by the direction of the arrows on all sides, and as such, potentially represent an engaged network that could possibly facilitate knowledge sharing. Group 2 (Light Blue, G2:21) may be considered negligible as 16 out of the 21 nodes have not a single score for Betweeness Centrality, and thus, they would have little or no impact on the network. Expanding the graph to show the nodes in each group (see Figure 13 reveals some of the nodes in group 2 (light green dots) are actually outliers that have no tie with the network at all as they have not engaged in any relationship with any other member of the network, either by mentioning or replying to, other than themselves by way of tweeting (self loop), hence, they have each scored zero in the betweeness centrality measurement. We can even spot 2 of them that have never tweeted within the timeframe and as such, they do not have the arrow-edged ring of self loop (tweet) but are standing aloof. The top 20 nodes are labelled 1 through 20 in order of their Betweeness Centrality while the top 12 are colour coded light green. Essentially, the groups are examples of subgroups in a one-mode network, in which measurement is based on just a single set of actors [80], albeit grouped according to their to their individual attributes of Betweeness Centrality.

Meanwhile, the chart in Figure 14 reveals that the Red, Dark Green and Green bars are in the top echelons of nodes with the highest Betweeness Centrality (a total of 23 nodes) while the bulk of the nodes in the entire graph - that is, a total of 70 nodes represented as Dark Blue bar on the chart - are with the lower range of Betweeness Centrality. With the highest Betweeness Centrality of 2,494.64 (Colour red on the far right), the node representing the egocentric network of @Unisouthampton, which is the official Twitter account of the University of Southampton, has over 40,000 followers. However, the measure of a node's Betweeness Centrality is not based on the number of followers but on the number of shortest paths from all nodes to all other nodes that pass through that node [91]. This explains why the node with only 558 followers (@sotonwsi) has the second highest betweeness centrality (522.543). Although it could be argued that both @unisouthampton and @sotonwsi are non-personal accounts, it must be noted that the node with the next highest betweeness centrality of 425.512 (@lescarr) has more follower count (2390) than the previous (@sotonwsi). The top 20 nodes by betweeness centrality can be visualised in the network graph in Figure 13 (with each node labelled 1 through 20) while Table VI presents the individual metrics for 12 of the top 20 nodes (users), according to betweeness centrality, within the network. The node metric table (Table VI provides another interesting

Table VI: TOP 12 INDIVIDUAL NODE METRICS

No.	Node	Betweeness Centrality	Eigenvector Centrality	Page Rank	Clustering Coefficient
1	unisouthampton	2494.640	0.038	4.644	0.092
2	sotonwsi	522.543	0.037	2.764	0.198
3	lescarr	425.512	0.031	2.520	0.186
4	ecsuos	349.333	0.028	2.308	0.191
5	suukii	325.737	0.019	1.756	0.165
6	susanjhalford	206.940	0.029	2.065	0.227
7	damewendydbe	179.074	0.028	1.852	0.284
8	hughdavis	164.789	0.019	1.538	0.233
9	iliadsoton	150.258	0.015	1.646	0.174
10	webscidtc	146.866	0.026	1.784	0.268
11	richardgomer	134.370	0.14	1.321	0.180
12	sotonwais	115.194	0.015	1.176	0.233

aspect, which is that, another metric or a combination of metrics may be used depending on the intended purposes, although we have ranked these 12, out of 20 nodes, according to their scoring highest in Betweeness Centrality. For example, if the nodes were ranked in accordance with their Eigenvector Centrality, @susanjhalfod (No.6) would have ranked higher than @suukii (No.5). Eigenvector is a centrality measure that considers the value of a node, not in terms of its connections but in terms of the value of centrality of such connections [87]. In essence, the ranking of a node is based on the importance and/or ranking of the nodes it is connected to, which means @suukii may serve as bridge to propagate knowledge among a vast number of people than @susanjhalford, the connections are not as strong and vital within the network.

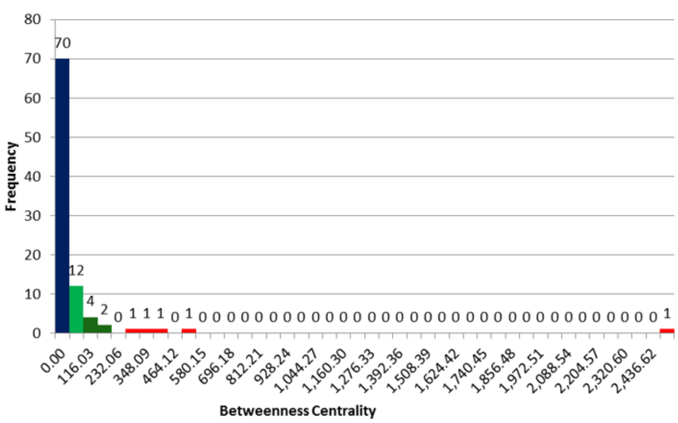


Figure 14: A Chart of Betweeness Centrality Spread among the 93 Vertices

F. Determination of an Engaged Workforce

With reference to our Knowledge Management Value measurement in Formula (1), where $KMV = AK \times EW$ (see KM Value in Section IV-E), we hereby devise a mechanism to determine the value of an engaged workforce (EW). We have established that the interactions that create the user network is based on users' activities in *tweeting* and/or *mentioning or replying-to* another user within their own tweets, thereby creating the relationships known as Edges in Table V. Each node in the network has been assigned to the groups in Table V based on individual node's measure of Betweenness Centrality. Table V also includes the graph density for each group. A sum of all the groups' graph densities equals 0.59, which indicates a sparse graph, owing that a dense graph is always equals to 1.

Graph density is an indicator of *connectedness* of a network, given as the number of connections in a graph divided by the maximum number of connections [93]. This *connectedness* is also a function of the interactions that create the relationships upon which the network is formed, as mentioned earlier. We therefore, measure *engagement* in terms of *graph density*. Whatever value we get for AK is either maintained or negated by the value of EW depending on whether the network is dense or sparse, respectively. This allows for the determination of Knowledge Management Value (KMV) to be inclusive of both values from AK and EW as indicated in Equation (4).

$$KMV = 0.56 \times 0.59 = 0.33 \tag{4}$$

This method can be used to compare Knowledge Management values derived from different KM activities/events or expressed in percentage to determine the return on investments on such activities/events.

VIII. Conclusion

This paper has presented *EMSoD*, a conceptual social framework that mediates between KM and SM, with the aim of delivering KM values to corporate organizations. The paper identifies *actionable knowledge* and *employee engagement* as parameters of KM values that the *EMSoD* framework helps in delivering. As KM has suffered an image problem due, in part, to the lack of measurable value, this paper proposed a mechanism devised for the measurement of the KM value delivered by the *EMSoD* social framework. Meanwhile, the paper has adopted very simple approaches, making it easy for any organization of any size to replicate the methods, not only for delivering KM value, but also for measuring and evaluating the KM values so delivered. Thus, the paper serves as basis and initial input for integration and operationalization of the *EMSoD* social framework within a corporate social software platform. To this end, it is important to, first, consider the interdependence and interactions between the core elements of the framework (as emphasized by the cyclical presentation of the *EMSoD* framework in Figure 3) as an iterative process that results in KM value for organizations, within the construct of social media. Then, the framework can further be modelled into entity relationship for database and software developers to operationalize by defining Entity classes that are independent of a database structure and then, map the core elements to the tables and associations of the database. This provides a suggestion for future direction to which this paper could be extended.

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