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Structural and Behavioural Models for Social Computing Applications

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Abstract

Social Computing, a new computing paradigm is causing transformational changes to societal and business processes resulting in new businesses models known as sharing economy, peer economy or collaborative consumption. Diffusion rates of these Social Computing applications have surpassed historical technological advancements and have reached millions and billions of users during a very short span of time. To understand this phenomenon we have analysed eight such popular applications using inductive content analysis techniques which have helped us derive a structural and a behavioural model for Social Computing. Using these two models we were able to get a deeper understanding of how an application designed to assist a particular communication pattern give rise to emergent characteristics within the user such as trust, empowerment, belongingness that motivate user to act to fulfil a need causing the growth of these applications. This understanding can guide the design of new successful Social Computing applications.

Keywords: Social Computing, Application Characteristics, Emergent Characteristics, Structural Model, Behavioural Model.

1 Introduction

Social Computing is increasingly bringing in transformations to many domains; some enhancing existing processes while others are introducing disruptive possibilities. Many traditional brick and mortar business models eTransformed (Hol and Ginige 2009) early in the new millennium. One such is almost two centuries old Australian iconic department store David Jones Ltd. Later in 2013 they extended their digital presence by successfully adopting Social Computing. They developed a social mobile catalogue and also made themselves present in popular social applications such as Facebook, YouTube, Twitter, Pinterest and Instagram. They also installed digital mirrors called omni-mirrors in their flagship stores which enabled images of shoppers fitting their desired fashion items, or photos posing with store ambassadors such as famous celebrity models to be automatically uploaded to social media. Within first quarter of adopting this store wide social policy in 4th quarter of 2013 they claimed in their ASX report that the sales have increased by 711% entirely due to Social Computing factor in excess to increments due to other factors (Reilly 2013). There are many similar success stories where existing processes have been transformed using Social Computing concept such as IBM using Blogs to improve communication and leadership processes (Hibbard 2010), Ford using Twitter and Blogs to enhance PR process (Israel 2012; Laskowski 2013), KPMG using a social collaborative platform to enhance collaboration process (Hughes and Chapel 2013), to name a few. On the other hand as past research has predicted new disruptive business models (Ginige 2004) are being introduced alternately known as sharing economy, peer economy, crowd companies, market economy (Economist 2013) or collaborative consumption (Botsman and Rogers 2010) all of which are paper less and some with minimum back office operations are solely based on a web or mobile application.

Many of the popular Social Computing applications have evolved as a result of few individuals or small teams trying to develop an information technology based response to a challenge that they have faced as in the case of Facebook or identify an opportunity that can be fulfilled and generate a revenue as Airbnb, Uber and likes in the aftermath of global financial crisis. Rapid global diffusion and exponential growth curves are a common characteristic of these applications such as social interaction platform Facebook initiated in 2004 today has reached almost one fifth of the global population, having 1.6 billion monthly active user community (Statista 2016). The content sharing site YouTube which was originated in 2005 has reached 1.0 billion user community today (Statista 2016). On the other hand the accommodation sharing business application Airbnb established in 2008 has now surpassed all existing hotel chains and claims 60 million user community, being present in 190 countries and 34,000 cities. The ride sharing platform Uber which was founded in 2009 today has reached a user community of 8 million and even more importantly the socio economic and environmental benefits this business enhancement bring about have caused countries, states and cities including Sydney, ACT and Melbourne to consider revising their legal policies to accommodate these Social Computing advancements.

Yet scholarly literature does not provide a clear basis to understand this new phenomenon of rapid growth of some of the Social Computing applications and some new disruptive business models that challenge the existing business models today. In our early work we developed a broad taxonomy of social Computing characteristics as a starting point to better understand this phenomenon and developed a structural model of a Social Computing application (Ginige and Fernando 2015) Next we identified that there is a causal relationship among various categories of characteristics that we identified earlier. Based on this finding we developed a behavioural model (Fernando et al. 2016) to further assist us to understand this phenomenon. In this paper we present a summary of our earlier work and report our investigations to understand how structural aspect of Social Computing application gives rise to the observed behavioural aspects.

2 Overview of Related Literature

We embarked on a study to find possible underlying models and theories to explain the observed phenomena described above so that this insight can assist in developing successful Social Computing applications. First we looked for definitions and characteristics of Social Computing in published scholarly literature. Though there was no widely agreed definition, all definitions indicated that it is to do with the interaction of people with computers as shown in the *Table 1* below.

Authors	Definition of Social Computing
(Parameswaran and Whinston 2007)	Social computing is a set of applications and services that facilitate collective action and social interaction online with rich exchange of multimedia information and evolution of aggregate knowledge.
(Fu et al. 2009)	Social computing is the natural evolution of collaboration: a shift from a focus on content to focus on people.

(Wang et al. 2007)	Social computing is a computational facilitation of social studies and human social dynamics as well as the design and use of ICT technologies that consider social context.
(Charron et al. 2006)	Social computing is a social structure in which technology puts power in individual and communities, not institutions.
(Schuler 1994)	Social computing is described as any type of computing application in which software serves as an intermediary or a focus for social relation.
(Hassan 2008)	Social computing is the interplay between persons' social behaviour and their interactions with computing devices.

Table 1. Definitions of Social Computing found in Scholarly Literature

A wide range of characteristics relating to Social Computing has also been reported in literature as in the Table 2 below, but there was no clear taxonomy of these characteristics.

Source	General Characteristics
(Parameswaran and Whinston 2007)	Decentralized, Highly dynamic, Highly transient, Loosely defined structure, Fluid boundaries - overlaps with other stake holders like customers scope, Rich content, enhanced by dissemination structures, peer influence mechanisms, Highly mobile, Very high scalability
(Hassan 2008)	Bottom-up, Collaboration, Collective action, Communication, Communities, Community interactions, Decentralized, Democratic approach, Disseminate social information, Dynamic content, Dynamic information spaces, Easy to deploy and use, Flexible structure, Focus on social relations, Free content, Free-form structure, Gather social information, Grassroots, Hyperlinks and cross- references, Informal, Information sharing, Interactive, Large scope of interaction, Lightweight, Mash-up, No governance structure, Online, Output to the network, Ownership by creators and users, Portable, Process social information, Relationships, Represent social information, Rich content, Scalable, Sharing, Social interactions, Social networks, Transparent, User diversity, User-generated content
(Huijboom et al. 2009)	Empowerment, Transparency of users, Instant hype wave, (online communities are more) Inclusive, Community sense, In perpetual beta, Efficient allocation of resources, Long tail effect

Table 2. General Characteristics of Social Computing found in Scholarly Literature

As seen above though there were many scholarly articles on Social Computing we could not find a systematic categorisation of Social Computing applications and associated characteristics. This also got reflected in the range of definitions found in literature as shown earlier. Thus we decided to explore whether it is possible to find a useful categorisation based on most widely used social computing applications and see whether we can identify some common and some specific aspects among different categories of Social Computing applications.

3 Categorisation of Existing Social Computing Applications

In this paper we looked at eight applications that have most number of users and used inductive analysis to categorise these based on major functionality these provide.

Application	Year Started	Number of Users Today	Major Functionality
Facebook	2004	1.6 billion	Social Interaction
YouTube	2005	1 billion	(Video) Content Sharing
Blogger	1999	540 million	(Text) Content Sharing
Instagram	2010	500 million	Social Interaction
Airbnb	2008	60 million	Business Transaction
Wikipedia	2001	28 million	Content Sharing
Coursera	2012	15 million	Learning Facilitation
Uber	2009	8 million	Business Transaction

Table 3. Popular Social Computing Applications based on user numbers published in (Statista 2016)

We identified four main categories among these widely used applications based on major functionality provided by the application; Social Interaction (SI), Business Transactions (BT), Content Sharing (CS) and Learning Facilitation (LF). Social Interactions happens on a continuous basis. Business Transactions take place to meet a need; within Airbnb to find some short-term accommodation or within Uber to find a ride to go from one location to another. The functionality associated with content sharing can be one of two possibilities. In case of YouTube the author uploads a video. Other users watch this Video. They also have the ability to comment and inform others about the video. In case of Wikipedia few users collaboratively develop the contents to be read by others. The Learning Facilitation applications use both types of Content Sharing and discussions or question answering type activities based on shared content to facilitate learning. These activities can happen synchronously and asynchronously. All these functionalities were supported by the most recent technologies: mainly the

two way rich multimedia communication based on Web 2.0, broadband mobile and WiFi connectivity and front end devices with sensors such as smart phones and backend Cloud Computing. Above inductive analysis provided a basis to broadly categorise different applications and an understanding of broad application characteristics.

3.1 Identifying Causality and Methodology Adopted

To get an understanding of how different people have perceived the functioning of these Social Computing applications we collected grey literature from established business magazines such as Economist, Forbes, Harvard Business Review, Bloomberg and analysed 3 or more articles from different authors per each scenario. This enabled us to gain an aggregation of different perspectives relating to these applications. For this analysis we used qualitative inductive content analysis techniques. We open coded these original text of the selected 8 popular applications using NVivo11 and extracted causal relations engrained within the text in relation to *application*, its *characteristics* and its *societal or business outcomes*. When we came across one of these three themes while scanning the text we extracted the causality in relation to the theme as a brief code such as “A caused B” where “A” is the cause that gave rise to an effect “B”. A selection of causalities (codes) extracted from the original text are listed in *Table 4* below.

App	Original Text	Causality (Code)	Note
Facebook	Becoming self-aware by viewing one’s own Facebook profile enhances self-esteem rather than diminishes it (Gonzales and Hancock 2011).	Facebook enhanced self-esteem	“Self Esteem”: a feeling emergent within user
	Facebook use is motivated by two needs: belonging and self-presentation (Seidman 2013)	Facebook enable belongingness	“Belongingness”: a feeling emergent within the user
	“INSTANT ARTICLES” is a new service announced by Facebook on May 12th, in partnership with nine news firms, including the <i>New York Times</i> , the <i>Guardian</i> and <i>National Geographic</i> . Facebook users will be able to read stories from these publishers without leaving the social network, since it will host the articles rather than just providing weblinks (Economist 2015).	CS is convenient	Application characteristic CS is causing “Convenience”, a perception within the user
Instagram	Our library maintains a presence on four social networks—Facebook, Twitter, Pinterest, and Instagram—but we prize Instagram for being the place where we have the most rewarding interactions at the moment (Salomon 2013).	Instagram cause SI	Application caused the application characteristic SI
	Understanding how photo content might signify engagement, can impact both science and design, influencing production and distribution (Bakhshi et al. 2014)	CS caused engagement	Application characteristic CS causing an emergent characteristic Engagemen
	No wonder Facebook acquired the site in 2012, a move that that launched Instagram’s monetization via advertising (Barnes et al. 2015).	Instagram enabled advertising	Application enabled user action “Advertising”.
Blogger	Blogs, on the other hand, are dynamic and were developed to facilitate and accommodate frequent changes in content, particularly giving readers the opportunity to comment on the primary messages that appear on them (Barnes et al. 2015).	Blog enable SI	Application causing an application characteristic SI
	A second difference is in the ease with which content can be placed on a blog (Barnes et al. 2015).	Blog is easy to use	Application causing an emergent characteristic, a perception as “Easy to Use”
	An examination of this blog reveals that new content is added nearly every day, which is one of the primary characteristics of this electronic communication tool	Blog cause CS	Application has caused an application characteristic CS
YouTube	However, because very few YouTube channels prosper without a feeling of real connection to their audience. And for many of us there is a currency at stake—a feedback economy—paid in likes, comments, retweets, etc., that makes us feel digitally connected(Humphrey 2015).	YouTube caused connection	“Connection” is a feeling emergent within the user
	It is an interesting time to ask the question about self-presentation of YouTube stars, because several of the biggest, like Ezarik, have published memoirs or are about to(Humphrey 2015).	YouTube empowers users.	“Empowerment” is a feeling emergent within the user
	That, in essence, is the business model being pursued by websites that host “user-generated content” such as personal blogs, photographs and today’s craze, amateur videos, which can be uploaded and watched on sites such as YouTube (Economist 2006)	YouTube caused CS	Application causing an application characteristic CS
Airbnb	“WHY pay through the nose for something when you can rent it more cheaply from a stranger online?(Economist 2013)	Sharing accommodation is cheap	“Is Cheap” is a perception attributed to the application
	Online social networks and recommendation systems help establish trust(Economist 2013)	AK caused Trust	Application characteristic AK causing “Trust” a

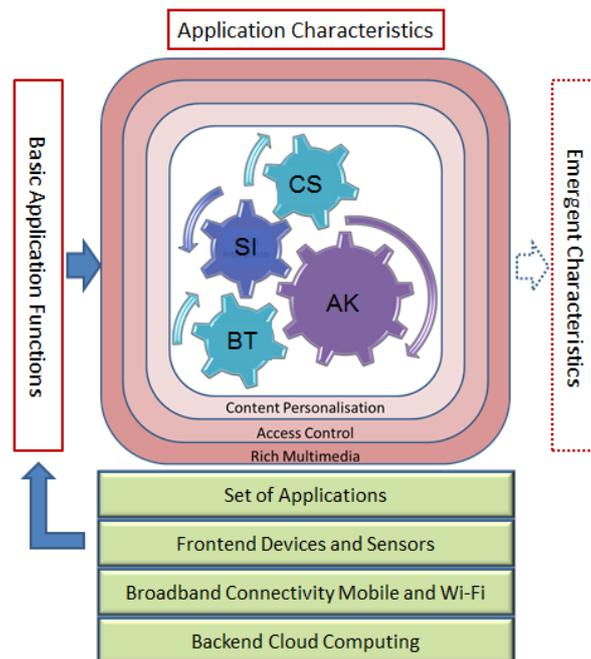
	But most importantly, Airbnb users are arguably engaging in the type of P2P transaction most reliant on trust to be successful: sharing a home with a stranger (Finley 2013).	Trust caused sharing	feeling emergent in user Emergent characteristic Trust causing user action "Sharing"
Uber	Uber is deeply committed to bring more economic opportunities to women across all communities in India. This partnership with iCare Life, the first of many, will empower women with the skill set and knowledge to provide a safe and high quality service in an industry traditionally dominated by their male counterparts. (Deval 2015)	Uber app empowered women	"Empowerment" is a feeling emergent within the user
	Most systems don't provide immediate confirmation when one user applies to rent something from another, allowing the provider to decide whether to proceed or not, based on the applicant's ratings (Economist 2013)	AK built Trust	Application characteristic AK causing a feeling "Trust" emergent within the user
	We have a fixed upfront price and our overheads are lower, without the minicab office and telephone operators (McVeigh 2014)	Application is less costly	A perception "less costly" attributed to application.
Wikipedia	Jemielniak nods briefly to the standard portrayal of Wikipedia as a collaborative place where the tyranny of experts has been broken down (Anders 2014)	Wikipedia is collaborative	"Collaborative" is a perception attributed to the application
	"Status, power and hierarchy" do matter in Wikipedia(Anders 2014)	Wikipedia empowers people	"Empowerment" is a feeling emergent within the user
	"Status, power and hierarchy" do matter in Wikipedia (Anders 2014)	Wikipedia gives self-esteem	"Self Esteem" is a feeling emergent within the user
Coursera	In the pre-Internet era, the gap between a Brazilian apartment and a Stanford, Berkeley or Penn lecture hall is unimaginably large. With a digital connection, that gap largely vanishes(Anders 2015).	App caused Connection	"Connection" is a feeling emergent within user
	In developed economies, 32% of Coursera's users reported tangible career benefits from taking an online class(Anders 2015).	App is beneficial	"Beneficial" is a perception attributed to application
	Within the U.S., MOOCs aren't turning out to be nearly as revolutionary as people originally thought, in terms of providing a wildly appealing, low-cost alternative to traditional university education(Anders 2015).	App is less costly	"Less costly" is a perception attributed to application

SI=Social Interaction, BT=Business Transaction, CS=Content Sharing, LF= Learning Facilitation, AK=Aggregated Knowledge

Table 4. Open Codes or Causality extracted from Grey Literature using NVivo11 Coding Tool

3.2 Structural Model for Social Computing

By open coding the original text of eight scenarios we analysed we extracted about 200 codes (causal relations). Codes such as "AK (Aggregated Knowledge) caused Trust" under Airbnb and Uber scenarios indicated that there is a causal relationship among different characteristics found in literature and this can provide a basis to organise these characteristics into some structure. We found that AK or Aggregation of Knowledge is a characteristic that occurs due to the functionality of the application, thus we categorised it as an Application Characteristic (ACH). While the characteristic Aggregated Knowledge (AK) played a dominant role grey literature helped us extract few more application characteristics namely Content Sharing (CS), Social Interaction (SI), Business Interaction (BI) that took many forms such as Learning Facilitation, Crowd Funding, Crowd Sourcing, etc. Same code "AK (Aggregated Knowledge) caused Trust" denoted that "Trust" is caused by the Application Characteristic Aggregated Knowledge (AK), where trust is a feeling, an emergent characteristic within the user due to usage of the application. Thus we categorised feelings or perceptions users attributed to the application as Emergent Characteristics (ECH). Extraction of Codes (Causalities) from grey literature also showed that there is a technology stack that enabled these applications in the first place. We have identified them as backend cloud computing, Wi-Fi or mobile broadband connectivity and frontend devices equipped with sensors. Technologies enabled the basic application functions such as create profile, post, like, comment, share, tag to name a few and also enablers or filters such as *two way rich multimedia* uploads supported by web 2.0 technology, *access control* enabling group formation and *content personalisation* to cater to different user profiles. Based on this we developed a Social Computing model consisting of structural and an early form of behavioural aspects that we refer to as Emergent Characteristics.



CS: Content Sharing, **SI:** Social Interaction, **BT:** Business Transactions
AK: Aggregated Knowledge, Also **LF:** Learning Facilitation not shown in the model

Figure 1: Structural Model for Social Computing

This Structural Model gave us a broader insight into Social Computing phenomenon. The structure of the application consists of some specific technologies that facilitate a basic set of application functions such as forms, links, buttons supported by a specific set of filters for content personalisation. These basic application functions are combined to provide higher-level functions such as content sharing (CS), social interaction (SI), business interaction (BI) and learning facilitation (LF). When users activate these functions the user actions get captured to generate aggregated knowledge (AK). These higher-level functions characterise the applications as shown in table 3; thus called Application Characteristics (ACH). In any given application these 4 application characteristics are placed as cog wheels that turn in tandem such that each characteristic influence the other. Different applications may have these characteristics in different combinations. One characteristic will always dominate while driving the others based on the main purpose of the application (Ginige and Fernando 2015).

3.3 Behavioural Model for Social Computing

We further analysed the causality we have extracted by developing causal chains. We placed the individual causal relations in a causal timeline supported with inductive reasoning as to which causality occur first giving rise to a certain effect which became the cause to an even higher effect. For example social application Facebook gave rise to below causal chain:

Technology → FB → Instant Articles (CS) → Convenient to read → Advertising → Revenue

Within this causal chain of Facebook, the relevant technologies have enabled this social application, Facebook has enabled instant articles which are news stories from news agents like Cannel 9, New York Times, the Guardian or National Geographic which are now placed on Facebook so that reader does not have to leave Facebook and follow the link to news website but can read straight from user's newsfeed. This facility belongs to Content Sharing (CS) characteristic of Facebook. This has caused convenience, an emergent characteristic within the user, a perception user attributes to the Facebook. Here we notice application characteristic *content sharing* cause emergent characteristic *convenience* that we found out through analysis of grey literature as we mentioned in Section 3.2 above. This convenience in reading has brought forth user action by Facebook, News Agent or any other third party as when these articles are displayed there is vacant space on the right hand panel of the newsfeed where advertisements can be placed. Either Facebook placed their own advertisement, sold the vacant

space to a third party or if the News Agent used the space Facebook charged 30 percent from them, thus bringing in revenue to either party.

Likewise we developed longest possible causal chains for each of eight scenarios analysed, namely Facebook, YouTube, Blogger, Instagram, Airbnb, Wikipedia, Coursera and Uber using the available grey literature. Longer the causal chain the causal series gave a better step by step understanding of the phenomena. Some causal chains had more links than the others, but they all followed a common causal path, causing pattern formation. The application characteristics that were discussed in Structural Model above gave rise to emergent characteristics, either a feeling such as Trust, Empowerment, Belongingness or a perception user assigned to the application such as Convenient, Cost Effective, Time Effective, within the user. These emergent characteristics ignited user actions such as Sharing, Buying, Selling which in turn gave rise to a social or business outcome such as Cost Reduction, Revenue Increase, Profit Increase. This helped us abstract a more refined common behavioural model for Social Computing as in *Figure 2* below.

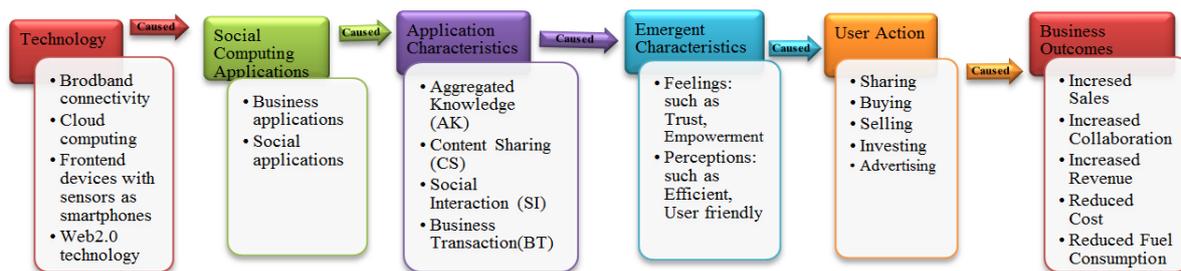


Figure 2: Behavioural Model for Social Computing excerpted from (Fernando et al. 2016)

4 Causal Inference among Structural and Behavioural Models

As seen from Structural Model for Social Computing, different Social Computing application characteristics are there to support a group of people to interact via different types of communication to achieve a goal or meet a need. The need could be a basic human need such as feeling of belongingness according to Maslow's hierarchy of human needs (Maslow 1943) or a secondary need as a part of organising a holiday, finding and booking suitable accommodation. When applying content analysis to the collected grey literature we identified following causalities where relating to application characteristic meeting the need. Thus we captured the screen shots of these application characteristics to understand how the specific application characteristic resulting from the way application is designed can give rise to emergent characteristics which then lead to action taking ultimately fulfilling a need.

Figure 3 below depicts a post on the profile of music celebrity Jennifer Lopez where she uploads an image with the hashtag #rebirth. This is Content Sharing (CS) and 147,000 of her friends, fans, followers have liked this post. Facebook has redesigned the "Like" button with 6 reactions namely "like", "love", "haha", "wow", "sad" and "angry" furthering the quick interaction facility. If you click on one of these emoticons it will show you the aggregated number of reactions by users by emoticon. This large number of likes emerge a feeling of *Self Esteem* within the celebrity. 4463 users have shared this post, which in turn will be viewed by friends and friends of friends of the users who shared which may cause potential new followers for the celebrity. We also see comments by the users to which Jennifer Lopez or her admin has responded, to which same user or other users re-commented and Jennifer or her admin re-responded making a long thread of communication as we can see in the first comment alone the thread is 25 comments long, which shall emerge a feeling of *Belongingness* to a community within the celebrity as well as her fans. This conversation may last for days, weeks or months and even after couple of years some user who is interested in the post may start a fresh conversation. Therefore we perceive that Social Interaction (SI) is generally open-ended.

Figure 4 below illustrates a unique property in the vicinity of Great Barrier Reef posted with the information of a special draw by the accommodation sharing business application Airbnb on their Facebook profile. This Content Sharing (CS) is been liked by a total of 3200 friends and followers, shared by 246 users, and commented by many asking business related questions as to how to enter the draw, whether this property is available during Christmas holidays, the rent of the property and so on to which Airbnb admin has responded with relevant business information. These large numbers of Likes cause a feeling of Esteem to the business and Comments cause a Community Sense by the

business creating a feeling of Belongingness in the users. This Content Sharing (CS) and back and forth communication though have taken place on Facebook is a Business Transaction (BT) as the outcome of the interaction is business based. But when the special draw is over the conversations will die or if a user wanted to book this property after the booking is made the conversation on this post may cease. Thus we perceive a Business Interaction (BI) is more of a close ended interaction may be with transaction follow ups.



Figure 3: Social Interaction



Figure 4: Business Interaction

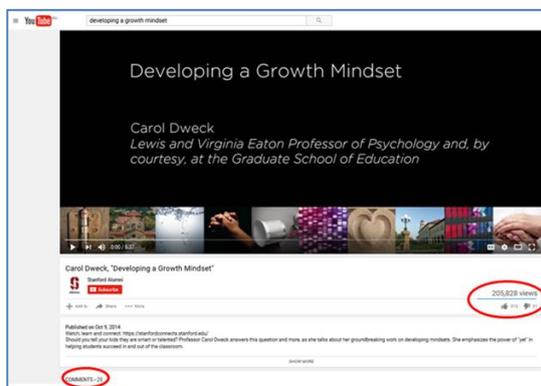


Figure 5: Content Sharing

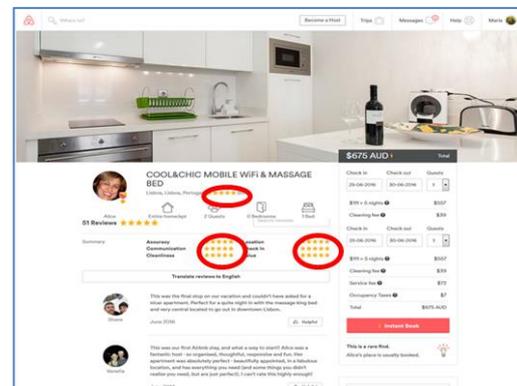


Figure 6: Aggregated Knowledge

Figure 5 above point up a video Content Sharing (CS) on YouTube platform. 205,828 YouTube users have viewed this content, 912 viewers have liked it and 21 have disliked it and there are 29 comments. Content Sharing (CS) on YouTube can either become a Social Interaction (SI), Business Transaction (BT) or Learning Facilitation (LF) depending on the type of content and the opportunities may avail from the post. For example this video is an educational content posted by a well-known educator, thus while it may be secondarily a Social Interaction (SI) for some, it is primarily a Learning Facilitation (LF) to many including the author. We also notice these aggregated values such as number of views, likes, dislikes and comments. Number of likes and views emerge a feeling of *Self Esteem* within the author, whereas number of dislikes a feeling of *Self Diminishing* and number of comments cause a feeling of *Belongingness* to a community within the author as well as users.

Figure 6 above is a property display interface of Airbnb application where textual and pictorial Content Sharing (CS) has taken place. More importantly we notice the application characteristic Aggregated Knowledge (AK) in play. The algorithmic analysis of the application has aggregated previous user reviews and rankings for this property and has rated it as a 5star property also presenting the review breakdown as Accuracy, Communication, Cleanliness, Location, Check In and Value where Location is 4 1/2star and rest is 5star. For a user who is looking to make an

accommodation booking this property rating plays a major role emerging a feeling of Trust within the user about the property. This will lead the user to take action such as a decision making and an ultimate booking resulting in a business outcome for the application owners such as revenue from rent for the host and 3% for Airbnb and a fulfilment of a secondary need such as holiday accommodation for the user. This demonstrates how application Characteristics give rise to emergent Characteristics which in turn cause User Actions resulting in Business Outcomes on these successful applications in real life as we theorised in our findings.

Way the application structure has been designed supports different communication patterns. Basic communication patterns can be categorised as Discussion Forums, Blogs and Wikis. All three publish to the worldwide web, enable collaborations, posts are made of thoughts, opinions and ideas while commenting on other people's ideas is encouraged. A discussion forum is topic centred where anyone can post about a topic of their choice and anyone can reply to begin a thread. Blogs are author centred where posts are made by the author and generally opinionated, anyone can comment, but the Blog as a whole will reflect author's identity in tone, look, feel and content. Wikis are content centred authored by a group of people, editable by any with version history, aim is to reach a consensus on the content, focus is on content not the author hence neutral and objective. Comments and discussions are separated from Wiki content. The basic communication pattern embedded in Facebook is a discussion forum communication pattern but enhanced by Aggregated Knowledge (AK) such as "Likes" which on the other hand directly link to Maslow's Level 3 and 4 need fulfilment; such as Belongingness and Self Esteem. If we closely look at the application characteristic Content Sharing (CS) there are 2 communication patterns. Wikipedia uses a Wiki and a Wiki allows collaborative editing of content. Alternatively the YouTube uses a Blog communication pattern because in a video collaborative editing or modifying is practically hard. In case of a picture album such as Pinterest or Instagram, they have a Blog communication pattern where multiple people can add to the Blog and comment.

When a communication takes place on any of these communication patterns we can capture information to generate Aggregated Knowledge (AK). For example it can be captured how many people downloaded, edited, contributed or liked. This Aggregated Knowledge (AK) which is an application characteristic (ACH) gives rise to Emergent Characteristics (ECH) such as Self Esteem on YouTube. Communication also directly and individually can give rise to Emergent Characteristics (ECH) such as an individual positive comment on your video clip on YouTube can also give a feeling of Self Esteem.

5 Reconceptualising Social Computing Phenomena

Thus we reconceptualised Social Computing as a set of web and mobile based applications facilitated by a technology stack of ubiquitous broadband connectivity, frontend devices with sensors, backend cloud computing and web2.0 technologies. These technologies enable a set of functions supported with two way rich multimedia communication, access control and content personalisation. These application functions yield application characteristics namely *content sharing*, *social interaction*, *business interaction* and *aggregated knowledge* all of which gives rise to emergent characteristics within the user which can either be a feeling like *trust* or a perception like *easy to use* which persuade User Action.

We perceive that the way these application characteristics are organised within an application enabling different degrees of communication as required by the designers and developers of an application can infer the prerequisite emergent characteristics within the user shaping the behavioural aspect of the application. These emergent characteristics that emerge within the user, first a feeling such as Trust, Empowerment, Belongingness, Connection, Confidence or Engagement, secondly give rise to a perception within the user that he or she attributes to the application such as it is Easy to Use, Convenient, Efficient, Cost Effective or Sustainable. Due to such feelings and perceptions within the user he/she is persuaded to act upon such feelings and perceptions by causing some User Actions such as Booking, Paying, Sharing, Investing or Advertising which in turn brings in value causing positive societal outcomes such as New Knowledge, Friendships, Popularity, Unique Experience or business outcomes such as Cost Reduction, Increased Revenue, Profit, More Customers, Unique Customer Experience, Growth, Scalability or Sustainability. When we say User Actions, psychologically it is perceived that humans act in such a way to fulfil a primary or secondary human need (Maslow, 1943). The analysis has helped establish that usage of some applications fulfilled a fundamental human need. For example within Facebook due to social interaction (SI) characteristic the communications take place in such a way making users feel belongingness to a certain community through commenting or receiving comments to their posts. Also users feel a certain amount of self-esteem due to receiving a

generous number of likes to their post. In each of these situations user fulfils a fundamental human need such as belonging which is Level 3 human need on Maslow's hierarchy and self-esteem a Level 4 human need. A fundamental human need is a definitive requirement by all human beings which leads to same user repeatedly using the application to gain that fulfilment again and again or more users beginning to use the same application. Thus we propose that this is the main reason for far and wide diffusion and rapid growth of the popular social networking application Facebook which is used by 1.6 billion users today. On the other hand a business application like Airbnb with its dominant application characteristic Business Transaction (BT) supported by Aggregated Knowledge (AK) gives rise to emergent characteristic Trust which in turn makes users share properties with strangers by fulfilling only a secondary human need as holiday homes or short term accommodations. Thus we propose this is the main reason why these popular business applications with a rapid diffusion rate and an exponential growth still reach millions whereas Facebook has reached and exceeded a billion.

6 Conclusion

This study has enabled us to derive taxonomy of characteristics by organising various Social Computing characteristics reported in scholarly literature as well as those found in the codes extracted from grey literature. Some of them materialised due to the functionality and communication patterns supported in the application which we categorised as Application Characteristics. Others emerged due to the behaviour of the users of the applications which we categorised as the Emergent Characteristics. Development of causal chains by inductively placing codes or causalities that were extracted in a causal time series as per sequence of occurrence revealed a multistage causal pattern. This sequential pattern showed that ultimate antecedent of the causal chain is enabling technologies which enabled Social Computing applications having specific application characteristics to support different interaction patterns to cause emergent characteristics which could be a feeling or a perception that emerge in the user leading to user action which caused ultimate societal or business outcome. We also found emergent characteristics in behavioural patterns are a result of different types of interactions supported by different types of communication patterns such as Discussion Forums, Blogs or Wikis. Thus how different communication patterns are supported in different applications in the way user interfaces are designed is a major factor in success or failure of Social Computing applications. We also found applications that support fulfilment of basic human needs such as Facebook or YouTube have a much larger user bases compared to social computing applications that support secondary needs such as Airbnb or Uber. These insights have helped us to better understand the Social Computing phenomena. This understanding of Structural and Behavioural models will help application designers to organise them in specific ways to achieve specific societal or business benefits by fulfilling a fundamental or secondary human need.

7 References

- Anders, G. 2014. "How Wikipedia Really Works." Retrieved 1 January, 2016, from www.forbes.com/sites/georgeanders/2014/06/30/how-wikipedia-really-works-an-insiders-wry-brave-account/
- Anders, G. 2015. "Coursera's Hunt for Feedback Reveals a Divided World." Retrieved 1 January, 2016, from www.forbes.com/sites/georgeanders/2015/09/22/courseras-hunt-for-feedback-reveals-a-divided-world
- Bakhshi, S., Shamma, D. A., and Gilbert, E. 2014. "Faces Engage Us: Photos with Faces Attract More Likes and Comments on Instagram," *Proceedings of the 32nd annual ACM conference on Human factors in computing systems*: ACM, pp. 965-974.
- Barnes, N. G., Lescault, A. M., and Holmes, G. 2015. "The 2015 Fortune 500 and Social Media: Instagram Gains, Blogs Lose " Retrieved 15 February, 2016, from <http://www.umassd.edu/cmr/socialmediaresearch/2015fortune500andsocialmedia/>
- Botsman, R., and Rogers, R. 2010. "What's Mine Is Yours," *The Rise of Collaborative Consumption*, (Collins).
- Charron, C., Favier, J., and Li, C. 2006. "Social Computing: How Networks Erode Institutional Power, and What to Do About It," *Forrester Customer Report*.
- Deval. 2015. "Uber Commits to Creating Thousands of Jobs for Women in India." Retrieved 1 October, 2015, from <https://newsroom.uber.com/india/2015/03/uber-commits-to-creating-thousands-of-jobs-for-women-in-india/>
- Economist. 2006. "It Attracts a Lot of Viewers, but Can "User-Generated" Video Make Money? ." Retrieved 1 January, 2016, from <http://www.economist.com/node/7855102>

- Economist. 2013. "All Eyes on the Sharing Economy." *Technology Quarterly* Q1 2013. Retrieved 1 February, 2014, from <http://www.economist.com/node/21572914/print>
- Economist. 2015. "Facebook and Several News Firms Have Entered an Uneasy Partnership." *The print edition* Retrieved 1 August, 2015, from <http://www.economist.com/news/business/21651264-facebook-and-several-news-firms-have-entered-uneasy-partnership-friends-benefits?zid=291&ah=906e69ado1d2ee51960100b7fa502595>
- Fernando, M. D., Ginige, A., and Hol, A. 2016. "Impact of Social Computing on Business Outcomes," in: *13th International Conference on Web Based Communities and Social Media (WBC2016)*. Madeira, Portugal.
- Finley, K. 2013. "Trust in the Sharing Economy: An Exploratory Study," *Centre for Cultural Policy Studies, University of Warwick*. Online verfügbar unter http://www2.warwick.ac.uk/fac/arts/threatre_s/cp/research/publications/madiss/ccps_a4_ma_gmc_kf_3.pdf, zuletzt geprüft am (2), p. 2015.
- Fu, A., Finn, C., Rasmus, D., and Salkowitz, R. 2009. "Social Computing in the Enterprise. Microsoft Vision for Business Leaders," *Microsoft White Paper*).
- Ginige, A. 2004. "Collaborating to Win-Creating an Effective Virtual Organisation," *International Workshop on Business and Information*, pp. 26-27.
- Ginige, A., and Fernando, M. D. 2015. "Towards Generic Model for Social Computing and Emergent Characteristics," in: *Asia Pacific World Congress on Computer Science & Engineering*. Fiji.
- Gonzales, A. L., and Hancock, J. T. 2011. "Mirror, Mirror on My Facebook Wall: Effects of Exposure to Facebook on Self-Esteem," *Cyberpsychology, Behavior, and Social Networking* (14:1-2), pp. 79-83.
- Hassan, H. A. 2008. "Corporate Social Computing Taxonomy Development," in: *Positive Design 2008*. Monterrey, Mexico.
- Hibbard, C. 2010. "How IBM Uses Social Media to Spur Employee Innovation." Retrieved 1 Jan, 2016, from www.socialmediaexaminer.com/how-ibm-uses-social-media-to-spur-employee-innovation/
- Hughes, C., and Chapel, A. 2013. "Connect, Communicate, Collaborate and Create Implementing an Enterprise-Wide Social Collaboration Platform at Kpmg-Part Two: Realizing Value," *Business Information Review* (30:4), pp. 191-195.
- Huijboom, N., van den Broek, T., Frissen, V., Kool, L., Kotterink, B., Meyerhoff Nielsen, M., and Millard, J. 2009. "Key Areas in the Public Sector Impact of Social Computing," *European Communities*).
- Humphrey, M. 2015. "Youtube Memoirs and Us: Are We Connecting to Real Lives?" Retrieved 1 October, 2015, from <http://www.forbes.com/sites/michaelhumphrey/2015/09/27/youtube-memoirists-and-us-are-we-connecting-to-real-lives/>
- Israel, S. 2012. "Social Media Thought Leader: Ford's Scott Monty [Part 1]." *Forbes* Retrieved 1 June, 2014, from <http://www.forbes.com/sites/shelIsrael/2012/05/29/social-media-thought-leader-fords-scott-monty-part-1/>
- Laskowski, A. 2013. "How Ford Became a Leader in Social Media." Retrieved 1 January, 2016, from <http://www.bu.edu/today/2013/how-ford-became-a-leader-in-social-media/>
- Maslow, A. H. 1943. "A Theory of Human Motivation," *Psychological Review* (50:4).
- McVeigh, T. 2014. "Uber: The Smartphone App That Is Driving London Cabbies to Distraction." *The Guardian* Retrieved 16th May, 2014, from <http://www.theguardian.com/technology/2014/may/17/uber-smartphone-app-cab-taxi>
- Parameswaran, M., and Whinston, A. B. 2007. "Social Computing: An Overview," *Communications of the Association for Information Systems* (19:1), p. 37.
- Reilly, C. 2013. "David Jones' Strategy Targets Omnichannel, Staffing and Store Renewal." Retrieved 1 February, 2014, from <http://www.retailbiz.com.au/2013/09/25/article/David-Jones-strategy-targets-omnichannel-staffing-and-store-renewal/GLUNCVUIBN>
- Salomon, D. 2013. "Moving on from Facebook Using Instagram to Connect with Undergraduates and Engage in Teaching and Learning," *College & Research Libraries News* (74:8), pp. 408-412.
- Schuler, D. 1994. "Social Computing," *Communications of the ACM* (37:1), pp. 28-29.
- Seidman, G. 2013. "Self-Presentation and Belonging on Facebook: How Personality Influences Social Media Use and Motivations," *Personality and Individual Differences* (54:3), pp. 402-407.
- Statista. 2016. "The Statistics Portal." Retrieved 15 February 2016, from <http://www.statista.com/>
- Wang, F.-Y., Carley, K. M., Zeng, D., and Mao, W. 2007. "Social Computing: From Social Informatics to Social Intelligence," *Intelligent Systems, IEEE* (22:2), pp. 79-83.

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