Social Computing: New Pervasive Computing Paradigm to Enhance Triple Bottom Line

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Abstract. Recent technological advancements such as cloud computing, broadband connectivity, two-way communication enabled by web 2.0, and frontend devices as smartphones has enabled a new pervasive computing paradigm termed Social Computing. In this paper we have derived a Structural Model, Multistage Causal Model and an Overall Interaction and Information Flow Model to understand how Social Computing paradigm can enhance the triple bottom line. The key to success of new business models known as peer economies, sharing economies, market economies or knowledge economies is the ability to establish trust amongst online users as well as online users and the system. The trust is a characteristic that emerges within a user based on previous experience with other users and the system. Trust is also transitive. The Multistage Causal Model showed us a way to generate this trust via a series of interactions and exploiting the transitive property by aggregating the individual experiences. The structural model showed us the essential structural elements of a Social Computing application required to support the behaviour depicted by Multistage Causality Model. Overall Interaction and Information Flow Model showed us by providing information in a systematic way how user interactions can be facilitated and by captured user interactions further information can be generated towards building the trust. When user reaches a sufficient level of trust to offset perceived risks associated when dealing with a stranger, business transactions take place to enhance the triple bottom line. This deeper understanding will enable businesses to design a successful Social Computing application to fulfil a specific need.

Keywords: Social Computing, New business models, Structural and Behavioural Models for Social Computing, Overall Interaction and Information Flow Model for Social Computing, Enhancing Triple Bottom Line, Designing successful Social Computing applications

1 Introduction

Increasing availability of broadband connectivity either mobile or Wi-Fi, two way rich multimedia communication owing to Web 2.0, frontend devices with a large variety of sensors and backend cloud computing-a greener option [1] have formed an ubiquitously connected world today. Size of this connected population amounts to

51% of the global population [2].We ascribe this ubiquitous connectivity as the enabler of this new pervasive computing paradigm termed Social Computing. Social Computing in a nutshell is a set of web and mobile based applications fulfilling societal and business needs to which we present an explanative definition in our previous work [3]. Two-way communication of these applications enabled age old community building practice online forming communities of scale that reached numbers as high as millions and billions [4]. Social interaction application Facebook founded in 2004 now has a user community of 1.79 billion [5]. This ability to build large communities has been successfully exploited by some entrepreneurs to build successful new business models based on Social Computing paradigm. Epitomic example is accommodation sharing platform Airbnb founded in 2008 and has reached a user community of 80 million today [5].

These applications gathered user information and provided users with personalised information such as if the user booked an accommodation the application suggested details of available travel, transport, food, entertainment, sightseeing, etc. This made the application cater not only to a single business need but converting it in to micro or mini business ecosystem. Yet another new business model enabled by Social Computing was Social Life Networks [6] that enabled the members of a livelihood make informed decisions thus empowering livelihood members. More recent knowledge economy model is Knowledge Ecosystems [7-9], an example from Sri Lanka where a mobile based information system is being used for achieving sustainable agriculture production. In this system farmers were empowered with right information, on time, in right context such that farmers could take informed decisions as to what crops to grow.

While introducing these new business models Social Computing applications also transformed the existing traditional brick and mortar businesses. Most traditional business models successfully eTransformed in the pre and early millennium by adopting eBusiness models [10-13]. Specific example is Australia’s almost two centuries old iconic department store David Jones Ltd. which eTransformed in 2003 and furthered their web presence by successfully adopting Social Computing in 2013. They launched their catalogue on a custom built business application and also became present in existing social applications such as Facebook, Twitter, Instagram, Pinterest and YouTube coupled with digital mirrors within their landmark stores which automatically posted photos to customers’ social profiles. They claimed in their ASX report that by doing so they gained 711% sales increase within very first quarter [14].

On the whole this pervasive computing paradigm is impacting business profit outcomes by increasing revenue, social outcomes by empowering community members to share information and make informed decisions and green sustainability by introducing environmentally sustainable practices through sharing properties, rides reducing energy consumption: thus enhancing triple bottom line (TBL).The triple bottom line (TBL) was first coined by Elkington [15] also known as three Ps: profit, people and planet, aiming to measure the financial, social and environmental performance of an organisation. Nevertheless from a very large number of Social Computing applications designed and developed today only 20% have become successful [16].The observed widespread impact of successful social computing applications and also the reported high failure rate of applications motivated us to carry out an in-depth study to identify essential characteristics of a social computing application for it to be successful.

2 Related Literature on Phenomenon of Interest

The key to success of above new business models known as sharing economies, market economies or knowledge economies enabled by Social Computing was ability to establish trust amongst online users as well as online users and the system. Thus we first reviewed pertinent literature to this concept.

2.1 Definitions of Trust

Concept of trust has been investigated by scholars of many different domains and the unanimous agreement of all scholars was that it is hard to define what trust exactly is as it is a multidimensional, multidiscipline and multifaceted concept [17]. Thus we reviewed how different scholars perceived trust.

Table 1. Scholarly Definitions of Trust

Author	Definition
Boon and Holmes, (1991)	A state involving confident positive expectations about another's motives with respect to oneself in situations entailing risk
Gambetta (1990)	A particular level of the subjective probability with which an agent will perform a particular action
McKnight and Chervany (2000, 2003)	A cross-disciplinary concept: related to social structure, concerns personal trait, is a mechanism of economic choice and risk management. Definitions of trust can be classified based on the consideration of structural, disposition, attitude, feeling, expectancy, belief, intention, and behaviour.
Corritore, Kracher, Wiedenbeck,(2003)	On-line trust is an attitude of confident expectation in an online situation of risk that one's vulnerabilities will not be exploited

2.2 Characteristics of Trust

In spite of diversity amongst existing definitions of trust and literature being short of a precise one, its characteristics offered an inclusive insight into this concept [17].

(1) Trust is directed
(2) Trust is subjective
(3) Trust is context dependent
(4) Trust is measurable
(5) Trust depends on history
(6) Trust is dynamic
(7) Trust is conditionally transferable
(8) Trust can be a composite property

To further our understanding of how online trust functioned we reviewed the generic trust model presented by Yao-Hua Tan [18]. This generic model for trust in e-commerce consists two basic components, party trust and control trust: trust in the other party and trust in the control mechanisms that ensure the successful performance of the business transaction [18]. Authors propositioned that individuals engaged in business transactions if their level of trust exceeded their personal threshold.

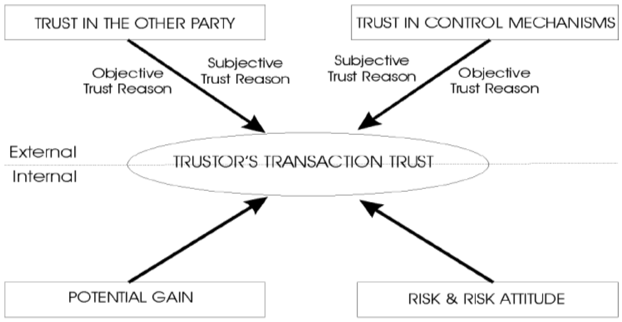

Figure 1. Generic Trust Model adopted from Yao-Hua Tan [18]

Level of trust required is high when the value of the business transaction is high. Level of trust required is low if the individual is a risk seeker. In the centre of the *Figure 1* above is trustor's transaction trust. The determinants of the trustor's trust threshold as potential profit, the risk involved, and attitude toward risk or risk propensity (i.e., a risk-seeker, risk neutral or risk-averse) are in the lower half. The upper half of the figure shows the determinants of trust, such as the trustworthiness of the other party in the transaction and the reliability of the control mechanisms as procedures and protocols that monitor and control the successful performance of a transaction. E-transaction can be enabled either by lowering an actor's personal threshold or by raising the actor's trust level related to the transaction, rationalised the authors [18]. Though this model was developed in e-commerce era its generalisation harmonises with and gives insight to current day online trust building mechanism within Social Computing paradigm.

Closely related literature to our phenomenon of interest was limited as this pervasive computing paradigm is considerably new. Early scholars reported survey results that there was a correlation between Facebook and enhancement in Communication and Collaboration Processes. But they failed to identify what this relationship was [19,20]. Social Computing being an abstract concept, to uncover a relationship or observe emerging pattern formation between Social Computing and triple bottom line we looked at deconstructs of Social Computing such as definitions and characteristics.

2.3 Definitions of Social Computing

We reviewed how early scholars perceived Social Computing. Though we could not uncover a commonly agreed definition, by tabulating we discovered emerging key concepts as in *Table 2*.

Table 2. A Summary of Scholarly Definitions of Social Computing

Scholarly Author	Key Concept in Definition
(Liu et al. 2010)	Social context
(Parameswaran and Whinston 2007)	Social interaction, Aggregate knowledge
(Fu et al. 2009)	Collaboration, Focus on people
(Wang et al. 2007)	Social context
(Charron et al. 2006)	Power in individual, Power in communities

2.4 Characteristics of Social Computing

Having gained some understanding what Social Computing is through scholarly definitions we further probed into current literature in search for why this computing paradigm is highly adopted and how we can make further advantage from same. This investigation retorted to our why question to certain extent with listings of generic characteristics of Social Computing as in *Table 3* below. Some characteristics were so generic that they were even present in Web 1.0. Some characteristics took more of a structural form while others were more behavioural. This gave us an indication that they needed a methodical categorization.

Table 3. Generic Characteristics of Social Computing

Author	Characteristics of Social Computing
Parameswaran, Whinston [21]	Decentralized, Highly dynamic, Highly transient, loosely defined structure, Fluid boundaries - overlaps with customers scope, Rich content, peer influence mechanisms, Highly mobile, High scalability
Hassan [22]	Bottom-up, Collaboration, Collective action, Communication, Communities, Community interactions, Decentralized, Dynamic content, Dynamic information spaces, Easy to deploy and use, Flexible structure, Free content, Free-form structure, Hyperlinks and cross- references, Interactive, Mash-up, Online, Rich content, Scalable, Sharing, Social interactions,
Huijboom et al. [23]	Empowerment, Transparency of users, Instant hype wave, (online communities are more) Inclusive, Community sense, In perpetual beta, Efficient allocation of resources, Long tail effect

Literature review strengthened the overall knowledge of key concepts arising from scholarly definitions, and some generic characteristics of it which indicated a need for a systematic categorization. But current scholarly literature has come short of a basis for the observed phenomena.

3 Developing a Causal Model to Understand Dynamics of New Business Models

The new business models built on Social Computing applications variously known as peer economy, sharing economy, market economy or knowledge economy are all based on exchanges among total strangers. For instance on accommodation sharing platform Airbnb a host opens up their home to a total stranger. On the other hand a traveling guest spends the night sharing accommodation at an individual premise owned by a lesser known total stranger or family. This business transaction has already taken place online before they physically met or exchanged premise keys through another mechanism. For any business transaction to take effect key is the trust: trust in the other party and trust in the control mechanisms that ensure the successful performance of the transaction as discussed under *Figure 1* above. Thus the key to success of these new business models is the mechanism to build trust. To uncover this multifaceted relationship as to how Social Computing is causing these new successful business models through trust building online and enhancing triple bottom line we carried out a deep causal analysis as below.

3.1 Methodology Based on Available Data

Despite current scholarly literature lacking an explanation to the "Phenomenon of Interest", the grey literature widely reported the societal and business transformations due to Social Computing. Thus we opted to analyse the available few scholarly scenarios in conjunction with well researched, up to date grey literature in reputed business magazines such as Economist, Harvard Business Review or Forbes, that reported the phenomenon. Author bias can be a concern when analysing secondary data. Scholars have postulated a Theory of Aggregation which articulates a random coefficient model that provided a natural approach to the problem of consistent aggregation. They demonstrated that least squares estimation in random coefficient model where data aggregated, was unbiased. They concluded that as the numbers in the aggregate N increase, the variance of the estimated parameters will tend to zero [24,25]. Hence we analysed three or more publications per scenario by different authors aggregating different author perceptions enriching the data set diminishing the bias.

Among several available methodologies we reviewed content analysis enabled downsize large textual data sets into a manageable yet contextually rich amount of data such that emerging patterns can be observed. Content analysis theorist Quinlan [26] says that systematic reduction of data is achieved through condensation first and then categorization. Condensation is performed by manually or automatically coding the text and categorization is done by further grouping. Content analysis can take either a qualitative or a quantitative attempt, a more progressive form is qualitative approach which will examine in which context a certain relationship appeared within the text. Content analysis also can take an inductive approach for theory building and deductive approach for evaluation of existing theory. To investigate in which context this causality between Social Computing and triple bottom line exists, and to extract same as a new theory, we opted for qualitative inductive approach of content analysis as the optimal methodology. To link the extracted individual causal relations in context to derive a reliable meaning we next used causal chain approach [27].

3.2 Open Coding

Open Coding helps condense large amount of textual data into a more adaptable yet contextually rich volume of data. This allows observation of any emerging patterns within the data. To begin open coding we did not have access to "Code References" or "Code Prescriptions" from the domain to guide us as Social Computing is fairly a new paradigm. Therefore we gathered scarcely available scholarly articles that reported supporting evidence of our phenomenon and open coded them such that we could use those codes as our "Code Reference" to open code our data set. We also had to decide what themes we would look for when scanning the large amount of text. Our phenomenon of interest is how Social Computing is enhancing triple bottom line hence Social Computing applications and triple bottom line necessarily became themes. Literature and our previous studies [3,28,29,4] revealed Social Computing characteristics play a significant role within the phenomenon. Thus *(1) Social Computing Applications, (2) Social Computing Characteristics* and (*3) Triple Bottom Line* became themes we looked for when scanning the text for open coding. When we came across one of these themes in a sentence or a short paragraph in the text we highlighted that chunk of text and assigned a brief code in the format of "A caused B" where "A" is the cause that gave rise to the effect "B". Exemplar is in below *Table 4* Parameswaran, Whinston [21] states "Popular blogs attract groups of users that engage in discussions" which we condensed into a textually meaningful code "Blogs caused Engagement" where "Blogs" are the cause and "Engagement" is the effect.

Table 4. Open Codes Extracted from Scholarly Text

Scholarly Text [21,30]	Causality	Cause	Effect
Due to broadband connectivity and powerful computers social computing has started growing phenomenally	Technology enabledSC (Social Computing)	Tech-nology	SC
Popular blogs attract groups of users that engage in discussions	Blogs caused engage-ment	Blog	Engage-ment
Wikis are popularly used as knowledge sharing tools	Wikis caused content sharing (CS)	Wiki	CS
Key feature of social computing trends is the use of easy-to-use, mostly open-source computing tools	SC is easy to use	SC	Easy to use
Focus on processing at the client contributes to consequent scalability;	SC is scalable	SC	Scalability
Social computing take the information infrastruc-ture to an environment for facilitating social interactions,	SC cause social interac-tion (SI)	SC	SI
Social computing networks find moderate use in placement and recruiting activities mainly by virtue of recommendations from peers.	SC gathered Aggregated Knowledge(AK)	SC	AK
Social computing networks find moderate use in placement and recruiting activities mainly by virtue of recommendations from peers	SC caused AK	SC	AK
	AK caused Recruiting	AK	Recruiting

We derived a considerable number of codes from scholarly text which became our "Code Reference" for our data analysis. These codes from generic literature took a more generic form such as "Social Computing application" whereas grey literature that reported about a specific scenario on a specific application gave rise to more specific terms such as "Airbnb application". We have used abbreviations such as SCN for 'Social Computing networks', or substitutions such as "content sharing" (CS) for 'knowledge sharing' in keeping with the context of this paper and parent research. All these assimilations and guidelines for 'how to open code' were documented in an "Open Coding Procedure" such that this study can be replicated.

3.3 Categorizing Codes

Open Coding helped condense the large amount of text into a long list of individual codes or causalities. In keeping with the content analysis theory we next categorized these individual codes that consisted of a cause and an effect. In other words we grouped these causes and effects as we perceived some of these causes and effects belonged to a more higher collective or generic group which we called ‘Super Class’ while others belonged to a more specific group which we called ‘Sub Class’. One example from *Table 4* above is that the effect in very first code “Social Computing” is more generic thus belongs to Super Class and cause in second code “Blog” is more specific thus belongs to Sub Class. Now there were six Super Classes beginning with primary antecedent of this phenomenon which is “Technology” that has given rise to Social Computing. Causality is a time series where something occurs first to give rise to another occurrence. Thus we used pure inductive reasoning to position these Super Classes in sequence in order of their occurrence and came up with *Table 5* below.

Table 5. Categorization of Open Codes from Scholarly Text

#	Super Class	Sub Class
1	Technology	Broadband connectivity, powerful personal computers
2	Social Computing Applications	Blogs, Wikis
3	Application Characteristics	Content Sharing (CS), Social Interaction (SI), Aggregated Knowledge (AK)
4	Emergent Characteristics	Engagement, Easy to use
5	User Action	Recruiting
6	Triple Bottom Line	Scalability

3.4 Constructing Causal Chains

Within our “Code Reference” in *Table 4* above we notice a certain pattern formation among last two codes: “SC caused AK” and “AK caused Recruiting”. We recognise a link between the two. But to link we need a sequence of the causality. This is where immediate sub section 3.3 above suffices with six sequential Super Classes which also contained Sub Classes. Thus we can link sequentially matching individual codes and develop long causal chains as below:

SC	➔	AK		
		AK	➔	Recruiting
SC	➔	AK	➔	Recruiting

One cause gave rise to an effect which became a cause to even higher effect. Some causal chains had more links while others had lesser number of links, hence to establish a generic pattern we needed a method.

3.5 Aligning Causal Chains

In *Section 3.3* above, we categorized all codes (causes and effects) into six Super Classes in sequence of occurrence. We used same rule to align causal chains in sequence. Thus we listed six Super Classes horizontally in a table as in below *Table 6* and aligned the causal chain underneath the relevant Super Class. Below are two causal chains derived from the same scenario: Facebook. While one causal chain took a shorter causal path of only 2 links the other took a longer causal path of 5 links, but systematic aligning illustrated they followed the same causal path. The short causal chain provided a valid causal inference between Social Computing and one bottom line yet the long causal chain contributed a more explanative step by step causal inference between Social Computing and one bottom line. Thus the scope of this study became deriving longest possible causal chains for each scenario.

Table 6. Aligning Causal Chains

Tech-nology		**SC App**		**ACH**		**ECH**		**UA**		**TBL**
		Face-book	→	SI	→					Commu-nity
Tech-nology	→	Face-book	→	SI	→	Belong-longingness	→	Shar-ing	→	Commu-nity

ACH=Application Characteristics, ECH=Emergent Characteristics, UA=User Actions. SI=Social Interaction

4 Multistage Causal Model and Structural Model

Our aim is to find out how Social Computing enabled enhancements to triple bottom line such that other businesses or even other domains can experience these benefits. As explained under Methodology section above, we analysed a large number of business scenarios and using NVivo11 extracted individual codes. The extracted codes from each scenario we imported into a code matrix such that pattern formation amongst codes is more visible. Then considering the six Super Classes we derived in *Section 3.3* above we linked individual codes in sequence of occurrence and developed longest possible causal chains.

4.1 Multistage Causal Model for Social Computing and Triple Bottom Line

Close investigation of longest causal chains of all scenarios formed a common pattern which we abstracted as a Multistage Causal Model for Social Computing and triple bottom line as in *Figure 2* below.

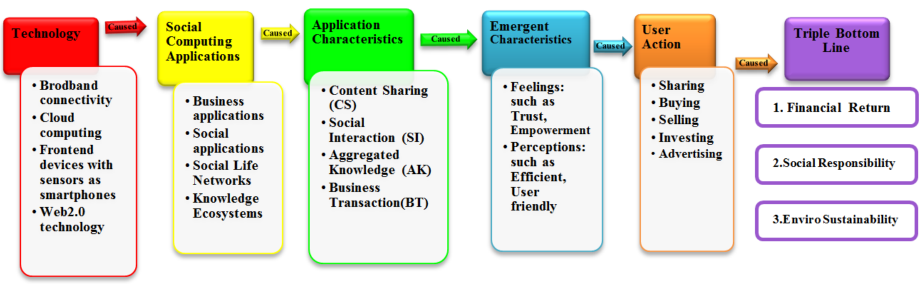

Figure 2. Multistage Causal Model for Social Computing and Triple Bottom Line

Thus we perceive that broadband connectivity, backend cloud computing, front end devices with sensors as smartphones and web 2.0 technologies have enabled Social Computing applications. These applications took the forms of business apps, social apps, social life networks or knowledge ecosystems. These applications comprised of 4 inherent dominant application characteristics (ACH) due to their functionality namely content sharing (CS), social interaction (SI), aggregated knowledge (AK) and Business Transaction (BT). Both SI and BT can be grouped as User Action (UA). The application characteristics CS and AK gave rise to emergent characteristics (ECH) within the user either a feeling such as connection, engagement, belongingness, self-esteem, trust, empowerment or a perception that the user attributed to the application such as easy to use, efficient, cost effective, or convenient. These emergent characteristics either a feeling or a perception triggered User Action (UA). Pertaining to basic psychology humans are motivated to act to fulfil a fundamental or secondary human needs [31]. It is these User Actions that fulfilled triple bottom line.

4.2 Structural Model for Social Computing

When the multistage causal analysis reached the categorisation stage it became clearly apparent that on the causal timeline the first half of causations were more structural and constructed the structure of Social Computing applications. The second half of causations was more behavioural and emerged within the user. The technology stack we identified as backend cloud computing, broadband connectivity mobile or Wi-Fi, front end devices with sensors as smart phones and two way communication enabled by web 2.0 enabled basic application functions. Basic functions included sign up, upload profile picture, status update, like, comment, share, tag, etc. supported with rich multimedia, access control and content personalisation.

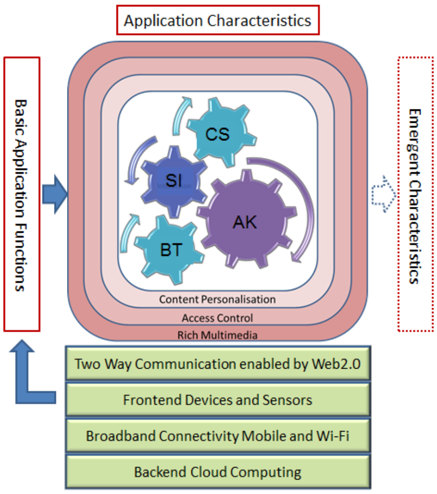

Figure 3. Structural Model for Social Computing

CS*: Content Sharing,* ***SI****: Social Interaction,* ***AK****: Aggregated Knowledge,* ***BT****: Business Transactions*

Functionality of the application gave rise to application characteristics we identify as content sharing (CS), social interaction (SI), aggregated knowledge (AK) and business transaction (BT). These application characteristics act as cog wheels in tandem as graphically represented in *Figure 3* above one influencing the other and AK plays a dominant role as depicted. Application characteristics give rise to emergent characteristics within the user which are a feeling or a perception after using the application.

5 Overall Interaction and Information Flow Model for Social Computing

For business transactions to happen feeling of trust needs to emerge within users to off-set any perceived risks postulated trust theorists Yao-Hua Tan [18] and Yan, Holtmanns [17]. The trust emerges about a person or a thing based on past behaviours.

Thus a starting point for information flow is CS (Content Sharing) and encouraging users to interact socially using the shared content as in *Figure 4* below. SI (Social interaction) as opposed to BT(Business Transactions) needs a low level of trust.

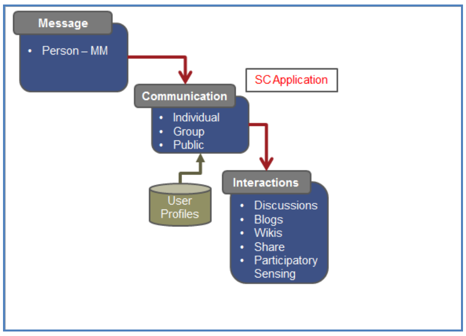

Figure 4. CS leading to SI

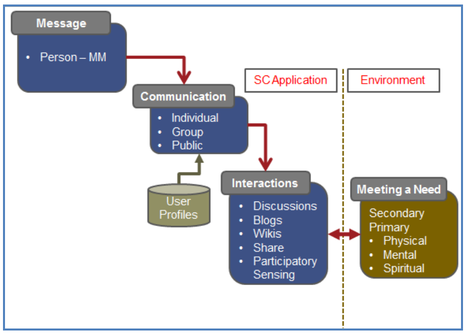

Figure 5. SI Meeting some Needs

Successful interaction will give rise to a feeling of belongingness thus meeting human needs and formation of a community as depicted in *Figure 5* above. The community theorists McMillan, Chavis [32] formulated in their “Theory of Community” four prime elements of a community: (1) Membership, (2) Influence, (3) Integration and Fulfilment of Needs and (4) Shared Emotional Connection. Thus it is apparent that forming into communities fulfil human needs. Membership gives a feeling that one has invested part of oneself to become a member and therefore a feeling of belongingness which is also an emergent characteristic (ECH) of Social Computing as per our analytical findings in Multistage Causal Model. Influence is a bidirectional concept where a member has influence over others and community has the ability to influence the member which happens through SI. Integration and fulfilment of needs can be better fulfilled within a community. Shared emotional connections are due to past experiences. Thus we perceive that community formation satisfies top 3 levels of human needs in Maslow's hierarchy of needs [31]: belongingness, self-esteem and self-actualisation. Communities also create a basis for communication.

Positive feedback in terms of comments and number of comments, "likes", "rankings", etc. give rise to a feeling of self-esteem if it refers to a person encouraging user to become an active member of the community and interact more. If these positive feedbacks, "likes" and rankings are about a product or a service it helps to build trust in that product or service. Here we can aggregate (AK) individual rankings and likes making use of the transitive property to increase the level of trust that will emerge within a user looking to buy a product or make use of a service. This can lead to a successful business transaction as illustrated in *Figure 6* below.

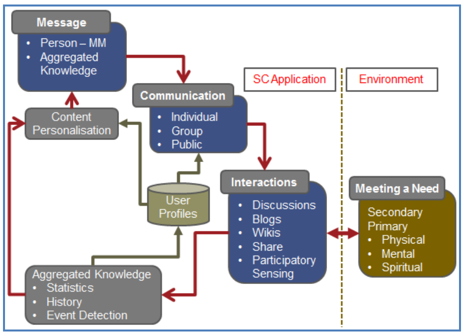

Figure 6. AK of SI

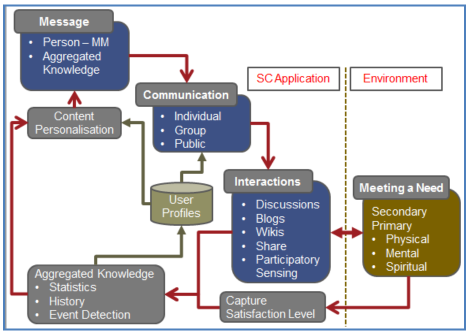

Figure 7. AK of Captured Satisfaction

After a BT (Business Transaction) the application should have a mechanism to capture the satisfaction level of the user that bought the product or made use of the service as in *Figure 7* above. This information can be aggregated (AK) to further boost the trust in the product or the service which will lead to more successful BTs.

Ability to successfully grow a community opens up other business opportunities such as 3rd parties to sell products or offer services to this community, completing the "Overall Interaction and Information Flow Model" as in *Figure 8*. This 3rd party information when take the form of products or services create new revenue streams to both 3rd party users as well as application owners.

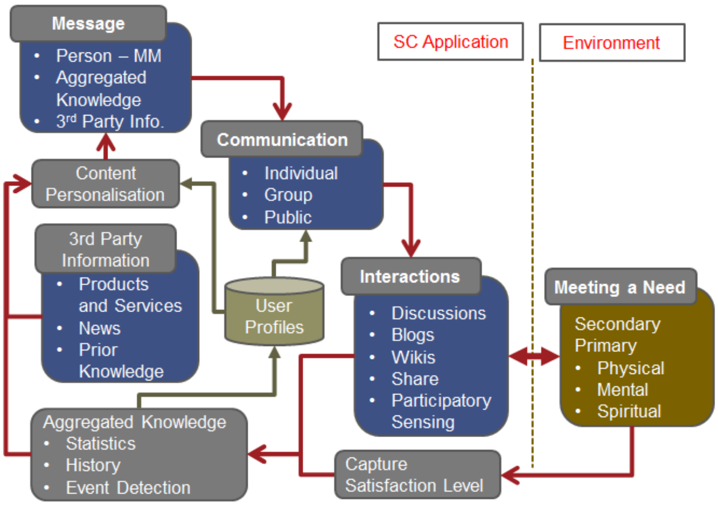

Figure 8. Model for Overall Interaction and Information Flow Patterns in Social Computing

Thus by providing specific CS to the intended community will effect in necessary SI. Aggregation (AK) of SI will enable initial trust building for BT to take effect. When initial BT takes effect the aggregation (AK) of captured satisfaction level will further increase trust effecting in more and more BT. These business transactions (BT) can take the forms of enhancing the business profit, social responsibility or environmental sustainability thus enhancing TBL.

6 Discussion and Conclusion

On the whole a new set of business models diversely known as peer economies, sharing economies, market economies or knowledge economies enabled by Social Computing are emerging and growing fast. These new business models solely enabled by Social Computing are impacting business profit outcomes by increasing revenue, social outcomes by empowering community members to make informed decisions and green sustainability by introducing environmentally sustainable practices through sharing properties, rides reducing energy consumption: thus enhancing triple bottom line (TBL). Success of these business models is due to the ability to build online trust among members of a community to meet needs and wants. There are many applications which have been unsuccessful. We looked at the ways successful applications have been able to establish this online trust. We did so by conducting the causal analysis. During this causal analysis when we categorised the causes and effects into Super Classes and Sub Classes we uncovered four application characteristics (ACH) that are giving rise to different types of emergent characteristics (ECH). With these findings then we mapped out how the information will flow and people will interact with that information enabling us to generate aggregated knowledge (AK). This AK helped to build online trust. This trust enabled business transactions (BT). When the BT happens the nature of the BT empowers society by supplying an additional income, supplying information to make right decisions, or reducing pollution. These business models enable the communities to meet their needs and wants by sharing existing resources. It could be an exchange of space, a ride, a video, a book, tools or vehicles to name a few. All these exchanges will either have a monetary value, will empower the user or will have environmental value thus enhancing the TBL. Thus we conclude that the 3 models we are presenting in this paper will help to get a deeper understanding of the emerging pervasive Social Computing paradigm and design successful applications to enhance the triple bottom line.

References

1. Baliga, J., Ayre, R.W., Hinton, K., Tucker, R.S.: Green cloud computing: Balancing energy in processing, storage, and transport. Proceedings of the IEEE **99**(1), 149-167 (2011).
2. Kemp, S.: We are Social. http://www.slideshare.net/wearesocialsg/digital-social-mobile-in-2015 (2015). Accessed 1 October 2015
3. Ginige, A., Fernando, M.D.: Towards a generic model for social computing and emergent characteristics. In: 2015 2nd Asia-Pacific World Congress on Computer Science and Engineering (APWC on CSE) 2015, pp. 1-10. IEEE
4. Fernando, M.D., Ginige, A., Hol, A.: Enhancing Business Outcomes Through Social Computing. IADIS International Journal on WWW/Internet **14**(2), 91-108 (2016).
5. Statista: The Statistics Portal. http://www.statista.com/ (2016). Accessed 15 February 2016
6. Ginige, A., Ginige, T., Richards, D.: Architecture for social life network to empower people at the middle of the pyramid. In: Information Systems: Methods, Models, and Applications. pp. 108-119. Springer, (2013)
7. Ginige, A.: Digital Knowledge Ecosystems: Empowering UsersThrough Context Specific Actionable Information. Paper presented at the 10th Multi Conference on Computer Science and Information Systems 2016 Funchal, Madeira, Portugal,
8. Ginige, A., Walisadeera, A., Ginige, T., Silva, L.D., Giovanni, P.D., Mathai, M., Goonetillake, J., Wikramanayake, G., Vitiello, G., Sebillo, M., Tortora, G., Richards, D., Jain, R.: Digital Knowledge Ecosystem for achieving Sustainable Agriculture Production: A Case Study from Sri Lanka. Paper presented at the The 3rd IEEE International Conference on Data Science and Advanced Analytics Montreal, Canada,
9. Hol, A., Ginige, A., Lawson, R.: System level analysis of how businesses adjust to changing environment in the digital eco-system. In: 2007 Inaugural IEEE-IES Digital EcoSystems and Technologies Conference 2007, pp. 153-158. IEEE
10. Ginige, A.: Re-engineering Software Development Process for eBusiness Application Development. In: SEKE 2003, pp. 1-8
11. Hol, A., Ginige, A.: Etransformation guide: An online system for SMEs. In: 2009 3rd IEEE International Conference on Digital Ecosystems and Technologies 2009, pp. 133-138. IEEE
12. Hol, A.: Online system to guide etransforming SMEs. University of Western Sydney (2009)
13. Ginige, A.: Collaborating to Win-Creating an Effective Virtual Organisation. In: International Workshop on Business and Information 2004, pp. 26-27

14. Reilly, C.: David Jones' strategy targets omnichannel, staffing and store renewal. http://www.applianceretailer.com.au/2013/09/gpwdvqjiay/#.WJ3AK_JK-jY (2013). Accessed 1 February 2014
15. Elkington, J.: Enter the triple bottom line. The triple bottom line: Does it all add up **11**(12), 1-16 (2004).
16. Oppong, T.: Over 50 Startup Founders Reveal Why Their Startups Failed https://medium.com/@alltopstartups/free-ebook-0ver-50-startup-founders-reveal-why-their-startups-failed-no-email-address-required-46b8e197bce2#.jp9i2k7bo (2015)
17. Yan, Z., Holtmanns, S.: Trust modeling and management: from social trust to digital trust. IGI Global, 290-323 (2008).
18. Yao-Hua Tan, W.T.: Toward a generic model of trust for electronic commerce. International Journal of Electronic Commerce **5**(2), 61-74 (2000).
19. Ellison, N.B., Steinfield, C., Lampe, C.: The benefits of Facebook “friends:” Social capital and college students’ use of online social network sites. Journal of Computer-Mediated Communication **12**(4), 1143-1168 (2007).
20. Suwannatthachote, P., Tantrarungroj, P.: How facebook connects students’ group work collaboration: A relationship between personal Facebook usage and group engagement. Creative Education **3**(08), 15 (2013).
21. Parameswaran, M., Whinston, A.B.: Research issues in social computing. Journal of the Association for Information Systems **8**(6), 22 (2007).
22. Hassan, H.A.: Corporate Social Computing Taxonomy Development. Paper presented at the Positive Desidn 2008, Monterrey, Mexico,
23. Huijboom, N., van den Broek, T., Frissen, V., Kool, L., Kotterink, B., Meyerhoff Nielsen, M., Millard, J.: Key areas in the public sector impact of social computing. European Communities (2009).
24. Kuh, E.: An essay on aggregation theory and practice. In: Econometrics and Economic Theory. pp. 57-99. Springer, (1974)
25. Zellner, A.: On the aggregation problem: A new approach to a troublesome problem. In: Economic models, estimation and risk programming: Essays in honor of Gerhard Tintner. pp. 365-374. Springer, (1969)
26. Quinlan, C.: Business research methods. South-Western Cengage Learning Andover, (2011)
27. Joshi, A.: Reading the local context: A causal chain approach to social accountability. IDS Bulletin **45**(5), 23-35 (2014).
28. Fernando, M.D., Ginige, A., Hol, A.: Impact of Social Computing on Business Outcomes. Paper presented at the 13th International Cnference on Web Based Communities and Social Media (WBC2016), Madeira, Portugal,
29. Fernando, M.D., Ginige, A., Hol, A.: Structural and Behavioural Models for Social Computing Applications Paper presented at the 27th Australasian Conference of Information Systems, Wollongong, Australia,
30. Parameswaran, M., Whinston, A.B.: Social computing: An overview. Communications of the Association for Information Systems **19**(1), 37 (2007).
31. Maslow, A.H.: A theory of human motivation. Psychological Review **50**(4) (1943). doi:10.1037/h0054346
32. McMillan, D.W., Chavis, D.M.: Sense of community: A definition and theory. Journal of community psychology **14**(1), 6-23 (1986).