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ENHANCING BUSINESS OUTCOMES THROUGH SOCIAL COMPUTING

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ABSTRACT

Within the past decade we have observed a new computing paradigm specified as Social Computing emerge and cause enhanced socio economic outcomes. Social Computing has introduced a myriad of web and mobile based applications. These applications have diminished the time and space restriction in communication and thus enabled synchronous as well as asynchronous communication alike. These new communication patterns have enabled traditional community building practices to modern online communities of scale such as social networking community - Facebook, content sharing community - YouTube, or business communities such as Airbnb or Uber. To better understand this phenomenon we analysed well researched social and business scenarios published in established business magazines such as Economist by applying Design Thinking methodological framework and qualitative inductive content analysis method. This methodological approach helped us traverse through mystery, heuristics leading towards an algorithm: a multistage causal model for enhanced business outcomes and Social Computing. Understanding of this causal inference sheds light in designing successful Social Computing applications to gain enhanced business outcomes by designing the application characteristics to give emergence to the necessary emergent characteristics.

KEYWORDS

Social Computing, content analysis, causal chains, online community formation, application and emergent characteristics, enhancing business outcomes

1. INTRODUCTION

Recent advancements in the Information and Communication Technology (ICT) has introduced new technologies such as broadband mobile and WiFi connectivity, back end cloud computing and front end mobile devices with sensors such as tablets, feature phones and most importantly smartphones. This enabled rapid global mobile penetration which has reached a 51% of world population (Kemp 2015) within the decade causing an ubiquitously connected society. This widespread connectivity has enabled the rapid diffusion of this new computing paradigm called Social Computing that involves many online social and business

communities. The largest human community in history is the online social networking community Facebook commenced 12 years ago and today has grown to be one fifth of the world population in size having 1.79 billion monthly active users around the globe (Statista 2016). It is noticed that within this massive Facebook community there are sub communities of interest such as games, entertainment, music, education, leisure, health, religious or political. YouTube which was launched in 2005 has built an online content sharing community that spans across the globe with a 1.0 billion monthly active users who view, like, dislike, tag or share each other's content (Statista 2016). Similarly there are many such social communities built upon social applications freely available for usage. These communities can be categorised depending on specific tasks the application enables users to perform such as blogging communities like Blogger, micro blogging communities like Twitter, wiki communities like Wikipedia, social collaboration communities such as Yammer, communication communities such as Messenger, and gaming communities such as Candy Crush. Recently we saw business applications emerged and gained rapid growth building massive online user communities around them. Airbnb, a web and mobile based accommodation sharing application founded in 2008, gained the fastest growth and has the highest user community. Today it has surpassed all the reputed hotel chains and has reached a guest community of 60 million with their presence in more than 190 countries in 34,000 cities with over 2 million host community having listed their properties with them (Airbnb 2016). There are many other applications for sharing accommodation such as Couchsurfing, Roomorama, HouseExchange, Knock, FlipKey and HomeAway to name a few. One year later, Uber a ride sharing application that created communities around drivers and ride seekers connected them efficiently as the location aware smartphone app enables users to pick the car located nearest to them. The user community of Uber has grown to an 8 million today with their presence in more than 375 cities around the globe (Uber 2016). RelayRides, BlaBlaCar, Lyft, Zipcar, FlightCar are a fraction to name from the large amount of car sharing communities built on Social Computing applications. These peer to peer access driven business models based on Social Computing applications are transforming established business processes whether borrowing goods, renting homes, taxi services or serving up micro-skills in exchange for access of another product or service, or for money. Many traditional brick and mortar business models eTransformed (Ginige 2006; Hol and Ginige 2009) early in the beginning of the new millennium. One example is almost two centuries old Australian iconic department store David Jones Ltd., and later in 2013 they extended their digital presence by successfully adopting Social Computing launching their catalogue on a custom built business application. Concurrently they made themselves present in existing social networking communities such as Facebook, Twitter, Instagram, Pinterest and YouTube and also launched 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 a massive 711% sales increase within the very first quarter exclusively due to Social Computing in addition to other increments due to other factors (Reilly 2013). There are similar success stories of existing large companies such as Star Bucks using their Facebook user community recommendations for product development, KLM introducing Meet&Seat application integrated with LinkedIn community such that travellers could pick adjacent passengers from a professional community they belonged to, which increased KLM customer base, Ford used Twitter community to enhance their PR process, IBM used blogging community to enhance communication, leadership and corporate identity, a few to name. Social computing based new business models relied on ratings and reviews to build trust

among their community members. Staying in a stranger's apartment or riding in a stranger's car in an unknown city seemed less daunting when one can read testimonials from previous users in the community. In addition, peer-to-peer businesses integrate with Facebook community to let members check to see whether they have friends or friends of friends in common (Economist 2013). Even though some of these social or business applications are adopted by masses, some applications such as StartupSQUARE, Pingjam, Cusoy, Everpix, failed (Oppong 2015) and how some applications became successful and others failed remains unclear. This mystery motivated us to explore this phenomenon: enhancement of business outcomes due to Social Computing.

2. REVIEW OF RELEVANT LITERATURE

The phenomenon of interest of this paper is the relationship between enhanced business outcomes and this new computing paradigm Social Computing. As Social Computing being an abstract concept we sought for literature that reported it in a deconstructed form such that our search for relationships would be more discernable.

2.1 Review of Social Computing Definitions

Our initial review was how scholars have perceived what Social Computing is and thus we list below the scholarly definitions of Social Computing in *Table 1* below.

Table 1. Definitions of Social Computing adopted from Scholarly Publications

Scholarly Definitions of Social Computing	Author/s
Social computing is a set of applications and services that facilitate collective action and social interaction online with rich exchange of multimedia and evolution of aggregate knowledge.	(Parameswaran and Whinston 2007b)
Social computing concerns the study of social behaviour and context based on computational systems.	(Liu et al. 2010)
Social computing is the natural evolution of collaboration: a shift from a focus on content to focus on people.	(Fu et al. 2009)
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.	(Wang et al. 2007)
Social computing is described as any type of computing application in which software serves as an intermediary or a focus for social relation.	(Schuler 1994)
Social computing is the interplay between persons' social behaviour and their interactions with computing devices.	(Hassan 2008)

These definitions indicated that there is a relationship between Social Computing and human behavior, not necessarily on user growth or large online communities or enhanced outcomes.

2.2 Review of Social Computing Characteristics

Next we reviewed literature that related fundamental properties of Social Computing: its characteristics. We found a very explanative deconstruct, a lengthy listing of Social Computing characteristics as in *Table 2* below.

Table 2. General Characteristics of Social Computing

General Characteristics of Social Computing	Author/s
Decentralized, Highly dynamic, Highly transient, Minimal loosely defined structure, Fluid boundaries - overlaps with other stake holders like customers scope, Rich content, enhanced by dissemination structures and peer influence mechanisms, Highly mobile, High scalability	Parameswaran and Whinston (2007a)
Available for others, 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, Online collaboration, 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	Hassan (2008)
Empowerment, Transparency of users, Instant hype wave, (online communities are more) Inclusive, Community sense, In perpetual beta, Efficient allocation of resources, Long tail effect	Huijboom et al. (2009)

Above lists contained duplication, also comprised Web2.0 and Web1.0 characteristics mixed together. Though they are Social Computing characteristics some of them indicated an analogical relation to business.

2.3 Review of Technologies that Enabled Social Computing

Technologies have seen revolutionary advancements since the historical times with introduction of tools, replaced by machine and automation until information technology took over in the 1960s (Castells 2011).If we considered a timeline of evolution of computing, first there were main frame computers then in 1970s mini computers were introduced, 1980s saw personal computers. These standalone computers were networked within the organisation enabling internal e-mail. Client servers were introduced in 1990s which extended these networks to world wide web (www) or Web 1.0. With further advancements in technology in early 2000s Web 2.0 was introduced with faster and two way scheme to data transfer (O'reilly 2007) making you not only an information consumer but enables two way communication allowing you to access as well as upload rich multimedia content through your browser, thus making you a data prosumer. With the introduction of Web 2.0 technologies one's browser could act as a micro server and thus individuals or organisations did not need maintain servers. Also, with the transfer rate of data and content creation by millions and billions of people who now have become prosumers the capacity requirement of a client server became larger and larger which pushed the client servers into cloud computing. Cloud computing is the practice of using a network of remote servers hosted on the internet to store, manage, and process data,

rather than a local server or a personal computer (Liu et al. 2013). Also, due to many technological developments we are now in a phase of human history of having unprecedented level of connectivity to exchange information digitally. In September 2015, 3.56 billion people, that is 51% of world population were part of this connected society (Kemp 2015). These connections have reached very efficient speeds known as broad band commonly referred to high-speed Internet access that is always on and faster than the traditional dial-up access. Mobile wireless broadband services are also becoming available from mobile telephone service providers. With the technological advancements that enabled faster data transmission speeds and backend cloud data storage facilities the frontend devices began to transform from heavy analogue devices to lighter digital mobile devices with microprocessors and a myriad of built in sensors. Initial digital cell phones were the second generation or of 2G technology has now been superseded by 4G technology with greater capabilities and increased speed to handle new features such as video, gaming and internet connection. Another significant feature of these front end devises are a myriad of sensors such as Accelerometer, Gyroscope, Proximity sensor, Magnometer. Barometer, GPS. Thus from all the Information and Communication Technology (ICT) advancements that took place during the recent past we identify the ubiquitous connectivity, front end devices with sensors, two way rich multimedia communication enabled by Web 2.0 technologies, and back end cloud computing as the technology stack that has fundamentally enabled Social Computing. This extensive review of scholarly literature provided an overall knowledge of what Social Computing is, what has enabled this new computing paradigm and some general characteristics of it, but has come short of a basis for the observed phenomena.

3. OVERARCHING METHODOLOGICAL THEME: DESIGN THINKING

We observed a new phenomenon where a new computing paradigm coming into action introducing a myriad of applications. These applications attracted millions and billions of users causing global online community formation causing social and business enhancements within very short span of time. But why this mass attraction towards this new innovation or this new computing paradigm was only a mystery. Thus we decided to adopt Design Thinking framework as our overarching methodological theme to solve this mystery. The author of Design Thinking concept Roger Martin (2010) apply the “knowledge funnel” concept to better understand the innovation process, which well aligns with the new phenomenon we have observed as a mystery and try to better understand same within this paper. To simplify the concept he takes the “Speedee Service System”, a prototype of quick-service restaurant introduced by McDonalds in 1950s as the example. McDonalds have converted their system into a science such that every store around the world have same sized, same weighted hamburger that came out of a stamping machine. Their cooking process too was unified across all the stores around the globe as it stopped automatically after a fixed number of seconds when the burgers reached a fixed internal temperature. This has helped eliminate variation in the process. Author of Design Thinking concept assign this practice into three steps of the Knowledge Funnel as below:

(1) Identifying a particular "Mystery" to be solved
(2) Developing an initial "Heuristic" or a rule of thumb
(3) Codifying the process, converting heuristic to an "Algorithm"

Design Thinker suggests that this is a valid model for businesses in any domain to advance knowledge and capture value and specifically a path followed by successful business innovations. We observed successful societal and business outcomes due to several Social Computing applications. Scholarly literature reported that there was a correlation between Facebook and enhancement in business processes such as Communication and Collaboration (Lampe et al. 2011; Suwannatthachote and Tantrarungroj 2013). But the literature was short of identifying what this relationship was, making it still a *Mystery*.

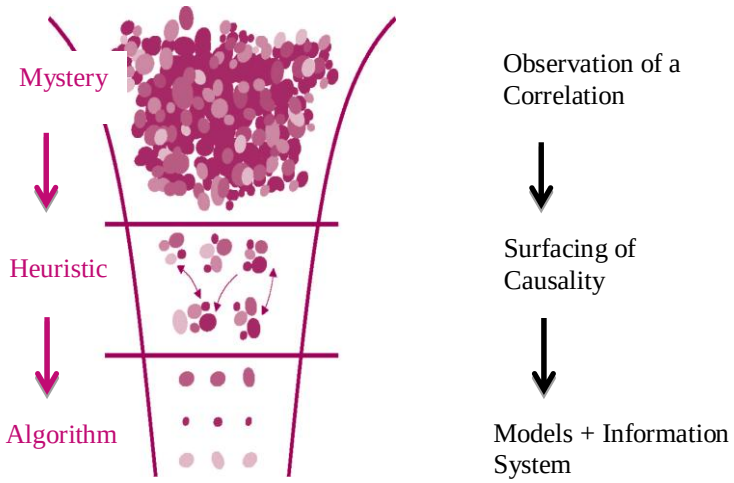

Figure 1. Overarching Methodological Theme: the Knowledge Funnel adopted from (Martin 2010)

To advance through the *Heuristic* slice of Knowledge Funnel we needed a suitable methodology. Our data set was well researched social and business scenarios published between 2010 and now in established business magazines such as Economist, Forbes, Harvard Business Review, Bloomberg which reported how successful social and business applications reached unprecedented user numbers by building colossal online communities around them effecting in enhanced business outcomes. We broadened the scope of this study to many such communities due to many different applications such that we could observe common patterns. From several scenarios analysed in this research, for the purpose of this paper we consider six scenarios. Four popularly used business applications which are also known as 'sharing economy' namely accommodation sharing community Airbnb, ride sharing community Uber, skills sharing community Skillshare and crowd sourcing community Fundrise. Our data set also consisted of most popularly used social interaction community Facebook and content sharing community YouTube. We sought for an optimal methodology to analyze this vast secondary textual data set and extract the deep causality between Social Computing applications and the exceptional growth of communities around them that caused societal and business enhancements. Amongst other methods content analysis method helps reduce the enormous textual information to a controllable amount. Key methods of reducing the amount of data are condensation and categorisation. Condensation is done by manually or

automatically coding the articles and categorisation is done by further grouping these codes (Blumberg et al. 2011; Quinlan 2011).Content analysis can take either a qualitative or a quantitative approach. In quantitative approach textual information is transformed into numerical data such as how often a certain word or relationship occurred in the text and then further analysed statistically. A more advanced form is qualitative content analysis which will examine in which context that certain word or relationship appeared within the data set. Also content analysis can be used inductively for theory building and deductively for evaluation of previously existed theory (Blumberg et al. 2011; Quinlan 2011). Thus to investigate in which context this causality between Social Computing and growth of communities leading to social and business enhancements exist, and to extract same as a new theory, we selected qualitative inductive approach of content analysis as the optimal methodology.

3.1 Extracting Causality by Open Coding the Text

One means of coding is to reduce the large amounts of textual data to a manageable yet contextually rich lesser amount of data such that we can observe emerging patterns. To perform coding we could not lay our hands on Code References or Code Prescriptions to refer to form the domain as Social Computing is quite a new paradigm. Scholarly literature that reported growth of online communities on Social Computing applications were hard to come by too due to the same reason. Thus is the reason our data set is grey literature that reported our phenomena. Hence to direct us in the process of Open Coding we first coded a few scholarly articles that provided supporting evidence of Social Computing outcomes and developed a "Code Reference" for us to refer when analyzing our data set. First we decided on themes to look for when scanning the text. Our phenomenon of interest is growth of communities on Social Computing applications that cause socioeconomic outcomes. Our previous studies (Fernando et al. 2016a; Fernando et al. 2016b; Ginige and Fernando 2015) signified that *Social Computing characteristics* played a dynamic role within the domain. Therefore we decided on three themes to look for as (1) *Social Computing applications*, (2) *Social Computing characteristics*, (3) *Socioeconomic outcomes* and. When we came across any of these three themes we highlighted that chunk of text and assigned the causality therein a short code in the format of "A caused B" where A=is the cause and B= is the effect. For example one scholarly article (Parameswaran and Whinston 2007b) comprised the sentence "Social computing shifts computing to the edges of the network, and empower individual users", we extracted the causality contained therein as "Social Computing caused empowerment". Within this code "Social Computing" is the cause while "empowerment" is the effect.

Table 3. Examples for Causality found in Scholarly Literature

#	**Scholarly Text (Parameswaran and Whinston 2007a; Parameswaran and Whinston 2007b)**	**Causal Relation (Code)**	**Cause**	**Effect**
1	It is due to the wide availability of broadband connectivity and more powerful personal computers that social computing has started growing phenomenally	Broadband connectivity enabled SC	Broadband connectivity	SC
2		Powerful computers enabled SC	Powerful computers	SC
3	Collectively, social computing represents the next step in the evolution of the Web, with great potential for social and business impact	SC caused business impact	SC	Business Impact

4	Popular blogs attract groups of users that engage in discussions using easy interfaces, and blogs often link to posts in similar or complementary blogs,	Blogs caused engagement	Blogs	Engagement
5	Wikis are popularly used as knowledge sharing tools	Wikis caused content sharing	Wikis	Content Sharing (CS)
6	Social computing networks find moderate use in placement and recruiting activities mainly by virtue of recommendations from peers.	SCN caused recommendations	SCN	Aggregated Knowledge (AK)
7		Recommendations caused recruiting	Recommendations (KA)	Recruiting
8	loyal readers leads to various means of leveraging that influence with significant economic impact: placing advertisements (*blogads*, for example)	Blogs caused economic impact	Blogs	Economic impact

Since above codes were extracted from generic scholarly literature some terms took a more generic form such as Social Computing (SC) but when analyzing grey literature of a specific scenario more specific terms such as 'Social Computing Application', or 'Airbnb App' is extracted. To make the code as brief as possible we used common abbreviations such as SCN for 'Social Computing networks', similarly a phrase such as 'knowledge sharing' we substituted with 'content sharing'=CS. These abbreviations and substitutions were listed and systematic steps for open coding were documented in an "Open Coding Procedure" such that this study can be replicated.

3.2 Grouping Causes, Effects

Open coding has helped extract the causalities found in textual data reducing the data set into a manageable set of individual codes. As the next step in content analysis to further reduce the amount of data so we can observe emerging patterns we categorized the causes and effects. We perceive that some of these causes and effects belong to a higher, collective and more generic group while others belonged to a more specific group. For an example the cause in 3rd code within the *Table 3* above was Social Computing (SC) a generic term while the cause in 4th code is Blogs a more specific term, similarly effect in 3rd code is business impact a more generic term while effect in 4th code is engagement a specific characteristic. Hence we grouped the generics as "Super Class" and specifics as "Sub Class" and arrived at 6 groups as in *Table 4* below. How we arrived at these six super classes is: *Technology* is the immediate antecedent or cause for Social Computing. For the rest of the causes and effects extracted we used the general inductive reasoning to place the causes and effects in a time series. As causality is a time series, we reasoned what occurred first to give rise to another occurrence and placed them in order of sequence as in the *Table 4* below.

Table 4. Cause, Effect Grouping using text from Scholarly Literature

#	Super Class	Sub Class
1	Technologies	Broadband connectivity, powerful computers
2	Social Computing Applications	Blogs, Wikis
3	Application Characteristics	Content Sharing (CS), Aggregated Knowledge (AK)
4	Emergent Characteristics	Engagement
5	User Action	Recruiting
6	Business Outcome	Economic impact

3.3 Developing Causal Chains

In the *Table 3* above, first code or the first causal relation reads as "Broadband connectivity enabled SC". 3rd code reads as "SC caused business impact". We perceive a link between these two independent causal relations where one cause gives rise to a certain effect, and that effect becomes a cause to an even higher effect as below.

Broadband connectivity ➔ SC

SC ➔ Business impact

Now if we linked these 2 causal relations it gives a causal chain as below:

Broadband connectivity ➔ SC ➔ Business impact.

Singular causal relations were extracted from the text. A closer inspection of these singular causal relations displayed emerging pattern that helped develop meaningful multistage causal chains as we did above. In the context of this paper the primal cause is "technologies" and ultimate effect is "business outcome". We do not know how many causal links will be there in between the two, but creating the longest causal chain will increase the reliability of this study such that this method can be applied to any other domain. A significant way to determine the correct order for a chain is to organise the links in the sequence of occurrence of causation using inductive reasoning. Causal links from literature will act as the "Code Directory" or "Code Reference" for this paper when developing new open codes from data. For example if Airbnb had 3 sources of data namely S1, S2 and S3, each source will give rise to different number of causal relations (codes) but a linking of matching individual causal relations as above will give rise to a more complete causal chain. Thus the scope of the data analysis is developing longest possible causal chains for each of the six scenarios we are analysing within this paper.

3.4 Aligning Causal Chains

Under section *3.2 Grouping Causes, Effects* exercise above we have identified six Super Classes into which all causes and effects can be categorized. These are (1) Technologies, (2) Social Computing Applications, (3) Application Characteristics, (4) Emergent Characteristics, (5) User Actions and (6) Business Outcomes. As the final step in our *Heuristic* or rule of thumb, we would horizontally arrange these six Super Classes in sequence and underneath will place the extracted causal chains in rows aligning specific cause or effect under relevant Super Class. This would help an abductive inference of a common pattern amongst the six scenarios we are analyzing within the next section.

4. ANALYSIS OF DATA

Advancing further through the *Heuristic* slice of the Knowledge Funnel towards developing an *Algorithm* we analyzed the selected grey literature that reported about our phenomenon of interest: extraordinary growth of online communities that cause beneficial social and business outcomes on social and business applications. With three themes *(1) applications, (2) characteristics, (3) business outcomes* as the guide to look for when scanning the text we open coded all six scenarios using analytic tool NVivo and extracted these nodes or causal

relationships as displayed in the *Figure 2* below. Each code represented a singular causal relationship such as "A caused B" where "A" is the cause and "B" is the effect.

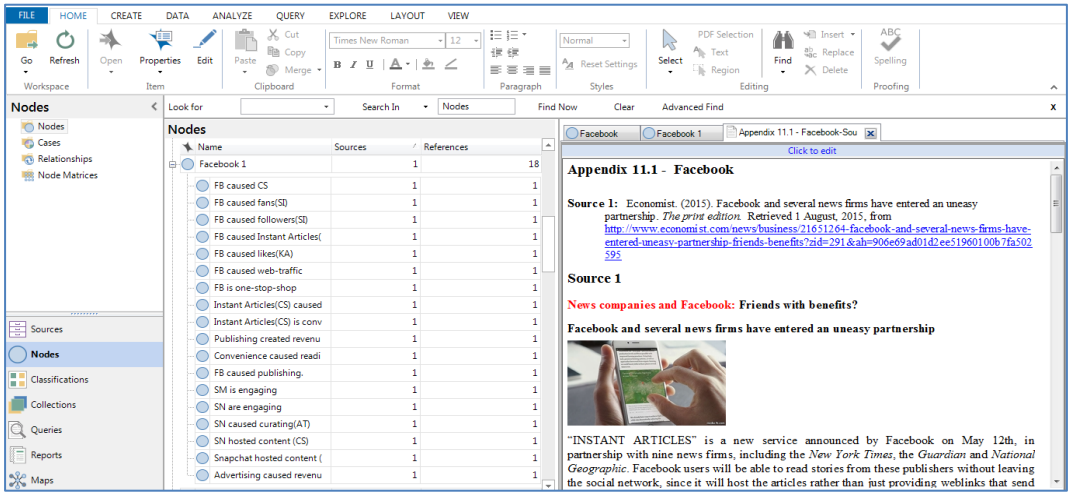

Figure 2. Open Codes (Causal Relations) extracted from grey literature using NVivo

Content analysis has enabled to condense the vast amount of textual data into a manageable and contextually rich amount of nodes as shown above. Each scenario consisted of average 28 nodes. We extracted these nodes into a Node Matrix such that pattern formation amongst individual nodes can be easily observed. For the six scenarios we are analyzing for this paper we have extracted a total of 174 codes of which only a sample is displayed in *Table 5* below.

Table 5. Code Matrix

Source Name	Source#	CODE#	CODE	Source Name	Source#	CODE#	CODE
Airbnb	S1	1	Accomodating fulfilled a need	Airbnb		19	Sharing caused environmental bebefits
		2	App caused browse accommodation			20	Sharing caused income
		3	App caused economic growth			21	Sharing is cheap
		4	App caused list accommodation			22	Sharing is convenient
		5	App caused location identification			23	Sharing is less costly
		6	Income fulfilled a need			24	Smartphne enabled AK
		7	Internet aggregated supply			25	Testimonials(AK) caused trust
		8	Internet aggregated demand		S2	1	App caused faster growth
		9	Internet enabled billing		S3	1	App caused belongingness
		10	AK caused Trust			2	App caused connection
		11	AK found nearby acommodation			3	App caused unique experience
		12	Need caused Community			4	App cut cost
		13	Ratings(AK) caused trust			5	App filled empty spaces
		14	Reccommendation system(AK) caused trust			6	App generated income
		15	Renting fulfilled a need			7	App is scalable
		16	Reviews(AK) caused trust			8	App is user friendly
		17	Reviews increased demand			9	Sharing enabled meet demand
		18	Sharing caused efficiency		S4	1	Trust enabled sharing

AK=Aggregated knowledge,

Executing the grouping method as in *Section 3.2* of our methodology we grouped the causal relations extracted from data as in the *Table 6* below.

Table 6. Cause, Effect Grouping using Data

	Super Class	Sub Class
1	**Technology**	Internet, Smartphone
2	**Social Computing Application**	Social Networks(SN), Social Media (SM), Facebook(FB), Blogs, Wikis, YouTube, LinkedIn, Airbnb
3	**Application Characteristics**	Aggregated Knowledge (AK), Content Sharing(CS), Social Interaction(SI), Business Transaction (BT), Ratings, Recommendations, Reviews
4	**Emergent Characteristics**	Community sense, Belongingness, Collaboration, Easy to use, Dynamic, Trust, Goodwill, User friendly, Empowerment
5	**User Actions**	Marketing, Recruiting, Content Creating, Sharing, Browsing, Listing, Billing
6	**Business Outcomes**	Promotion, Business Impact, Innovation, Scalability, Rapid Growth, Brand Visibility, Bargaining Power, Extra Income, Nearby Accommodation, Economic Growth, Demand, Efficiency, Cheap, Environment Benefits, Convenience, Less Cost, Fast Growth, Unique Experience, Cot Cost, Filled Empty Spaces, Income, Scalability, Meet Demand

We tabulated these Super Classes in sequence of occurrence based purely on inductive reasoning as technology had been the antecedent or cause to give rise to Social Computing applications. Social Computing applications with their different functionalities give rise to application characteristics. Application characteristics induced different emergent characteristics in the users: a feeling or a perception. These feelings and perceptions made users act in such ways and these user actions caused business outcomes. Code Matrix in *Table 5* above consists of individual causal relations which are the basic codes we extracted from the text that took the format "A caused B". But a closer look at this Code Matrix exposed that these singular causal links within a scenario even if they came from different sources S1, S2, S3 or S4 can be linked to each other. For example code # 10 of S1: "AK caused Trust" can be linked with code # 1 of S4: "Trust enabled Sharing". By linking such matching causal links together we can develop causal chains. A singular causal link for example code # 3 of S1: "App caused economic growth" adds value by highlighting that application has caused economic growth. But it is not explanative enough for someone to use this same App and obtain economic growth or use another app or even develop a similar app and gain economic growth or any other enhanced outcome in another domain. Thus we propose that we gathered as many possible related causal links within this scenario using *Table 5* and constructed longest possible causal chain that takes us from "App" to "economic growth" as in *Figure 3* below.

Facebook
Technology ➔ FB ➔ Instant Articles (CS) ➔ Convenient to read ➔ Advertising ➔ Revenue
YouTube
Mobile devices ➔ YouTube ➔ Content Sharing (CS) ➔ Community ➔ Advertising ➔Revenue
Airbnb
Technology ➔ Airbnb App ➔ Knowledge Aggregation (KA) ➔ Trust ➔ Sharing ➔ Extra Income
Uber
Smartphone ➔ Uber App ➔ Reviews ➔ Trust ➔ Transacting ➔ Income
Skillshare
Skillshare App ➔ Content Sharing (CS) ➔ Empowerment ➔ Teaching ➔ Revenue
Fundrise
Fundrise App ➔ Crowdfunding ➔ Community ➔ Investing ➔ Economic Development

Figure 3. Longest Causal Chains of Six Scenarios

Our aim was to construct the causal chain that undertook the longest possible path such that it would represent a more explanative and reliable causal inference. Above are the longest causal chains we derived from six scenarios but we could not make any inferences by inspecting them as they are. However *Table 6* above has categorized these causations into a set of six Super Classes. Thus following suit we tabulated the six Super Classes horizontally and aligned the causal chains of (1) Facebook, (2) YouTube, (3) Airbnb, (4) Uber (5) Skillshare and (6) Fundrise, underneath these Super Classes in rows as in the *Table 7* below.

Table 7. Aligning Causal Chains Under Super Classes

Scenario	Technology	SC App	ACH	ECH	UA	BO
Facebook	Technology	FB	Instant Articles(CS)	Convenient to read	Advertising	Revenue
	Smartphone	FB		Engagement		
YouTube	Mobile Devices	YouTube	CS	Community	Advertising	Revenue
		YouTube	CS			Scalability
Airbnb	Technology	Airbnb App	Reviews(AK)	Trust	Sharing	Extra Income
			Testimonies (AK)		Sharing	Cut Cost
Uber	Smartphone	Uber App	Reviews(AK)	Trust	Transacting	Income
		Uber App	Ratings(AK)	Trust		
Skillshare		Skillshare App	CS	Empowerment	Teaching	Revenue
		Skillshare App	CS			Skill Expansion
Fundrise		Fundrise App	Crowdfunding	Community	Investing	Economic Development
		Fundrise App		Community		Neighborhood Development

App=Application, ACH=Application Characteristic, ECH=Emergent Characteristic, UA=User Actions, BO=Business Outcome, FB=Facebook, CS=Content Sharing, AK=Aggregated Knowledge

When these causal chains were aligned under the "Super Classes" we began to observe a pattern of sequential causal advance like: cause ➔ effect ➔ cause ➔effect, such that an effect of one cause becoming a cause to a higher effect. Nor all scenarios achieved the same causal inference neither they consisted of same number of causal links.

For example 1st scenario Facebook comprised a complete causal chain beginning from first Super Class – Technology. Technology has enabled the social application Facebook. Facebook has enabled 'Instant Articles' by allowing third party newspaper companies such as New York Times to host their content on Facebook (Economist 2015) such that users can read the newspaper from their newsfeed without having to leave Facebook and being directed to a newspaper website via a weblink. This application characteristic *Content Sharing (CS)* has caused an *Emergent Characteristic(ECH)*: a perception in the user such that it is 'convenient to read'. Because of this convenience more and more of 1.79 billion Facebook users have

started reading the newspapers via Facebook. This has caused newspapers the ability to sell the advertising that appears next to their stories or let Facebook sell that advertising space on their behalf and give them a 30% cut. This causes the ultimate business outcome – revenue from advertising, to both parties, Facebook and third party newspaper companies.

If we considered the second causal chain of the same scenario the outcome is different. This too begins with a Sub Class of the first Super Class Technology: 'Smartphone'. The mobile device Smartphone has enabled Facebook. The next causal link skips 3rd Super Class and aligns under the 4th Super Class Emergent Characteristic: causing 'engagement' and the causal chain ends therein. Of course 'engagement' is an important characteristic towards business outcomes though not a final outcome, also how did engagement occur simply using Facebook, which application characteristic gave rise to the same, and what would be the effect of 'engagement' are all questions unanswered within this short causal chain. Hence is the importance of developing the longest possible causal chains which would explain the causal inferences step by step enabling a profound understanding of the entire causal process such that it becomes applicable anywhere.

Similarly within the business scenario Airbnb: *Technology* has enabled *Airbnb app*. App has enabled users to peer *review*: guests reviewed about the host and accommodation property while hosts reviewed the behavior of the guest causing *aggregated knowledge (AK)*. This aggregation of knowledge built a *trust* within the peers. This human trust enabled users *share* their properties with strangers they've only known online. This *user action* of sharing brought forth the ultimate *business outcome*: Extra Income.

Similar were the causal patterns identified within other scenarios YouTube, Uber, Skillshare and Fundrise each of which gave rise to scenario specific step by step causal inferences. This aligning made it possible to perceive though causal inferences were scenario specific they followed a generic to all sequential causal path thus helping us derive a qualitative multistage causal model for the phenomenon of interest of this paper.

5. MULTISTAGE CAUSAL MODEL FOR SOCIAL COMPUTING AND BUSINESS OUTCOMES

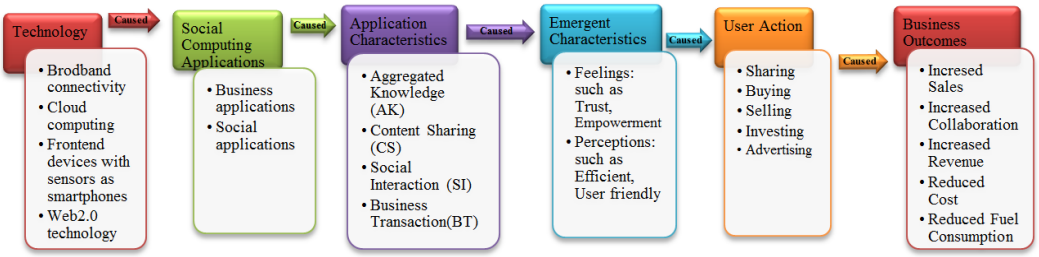

Figure 4. Multistage Causal Model for Social Computing and Business Outcomes

In Introduction and Literature Review sections of the paper we traversed through the *mystery* of the phenomenon of interest. We advanced through Methodology and Data Analysis sections developing a *heuristic* or a rule of thumb to solve the *mystery* observed. By consolidating the individual specific causal chains we have derived this generic model in *Figure 4* above which

highlights that the underlying causality between Social Computing and enhanced business outcomes take a multistage causal model leading us to an *algorithm.* Displayed on the top layer are generic causal stages and the bottom layer displays specifics for specific applications.

Some causal extractions from data illustrated singular causal relation from technology unto final business outcome such as "Smartphone caused economic growth" which is also correct but is not explanative enough. In contrast this model presents a more comprehensive multistage causal path of inference. Our analysis has helped categorise these multiple causal stages which we call super classes that sequentially advance until ultimate business outcome is met. Primary super class is the latest technologies that cause Social Computing applications. Next these applications cause several application characteristics. These application characteristics cause emergent characteristics within the user. These emergent characteristics cause users to act in such a way that causes these enhanced business outcomes such as cost reduction, revenue growth and sustainability. It is through knowing these causal steps and their dynamics that one can make use of these benefits using Social Computing.

Each of these causal super classes (generics) comprised of several sub classes (specifics) that played a significant role in this sequential causal model. 1st subclass comprised of enabling technologies such as powerful personal computers or mobile devices with sensors, broadband connectivity, cloud servers and web 2.0 technologies to name some. 2nd subclass comprised of social applications such as Facebook, YouTube or specific business applications such as Airbnb, Uber. 3rd subclass included application characteristics: *Social Interaction (SI), Content Sharing (CS), Business Transaction (BT)* and *Aggregated Knowledge (AK)* that gave rise to 4th sub class emergent characteristic which is a feeling within the user or a perception user assigned to the application. *Social Interactions* such as friending, creating groups, chatting caused connection, *engagement, community sense* or *belongingness* and users also perceived that the application is *easy to use, economical* or *efficient*. *Content Sharing* in the form of text, images, audio or video caused product/service *knowledge, self-esteem,* or *empowerment*. *Knowledge Aggregation* such as peer reviews, rankings, ratings, feedback, testimonials and system developed recommendations caused *trust* within the users: for the first time in history trust building took place online amongst total strangers causing users to act in such ways like buying, investing, sharing properties such as one's own home, apartments, rooms, vehicles and even rides. Since these user actions took place online user access was large in number, social applications had millions or billions of users as we discussed in *Section 1*, also as all business applications were integrated with social applications such as Facebook, Twitter or LinkedIn this caused rapid business diffusion thus causing scalability unto millions of users causing rapid growth. Thus this multistage causal model imparts a deeper understanding of how application characteristics cause emergence of emergent characteristics which in turn cause user actions enabling enhanced business outcomes.

6. EMERGENCE OF EMERGENT CHARACTERISTICS

To better understand how emergent characteristics emerge and lead to action tacking as discovered by generalizing the causal chains for different social computing applications, we examined the literature to find out how action taking relevant to business outcomes happen in a non-digital environment.

Maslow (1943) in his Theory of Human Motivation proposed that people are motivated to achieve certain needs, and that some needs take precedence over others. Most basic human need is physical survival. Once that level is fulfilled the next level up will become the motivation and so on, hence these needs are generally hierarchically displayed on a pyramid. The most fundamental need is physiological needs such as food, water, air, sex. Next Safety & Security needs such as health, employment, property, family. Level 3 is Love and Belonging needs such as friendship, family, intimacy. Level 4 is Self Esteem needs such as confidence, achievement, and Level 5 is Self Actualisation such as morality, creativity, spontaneity and acceptance.

McMillan and Chavis (1986) in their Theory of Community have articulated some aspects of community formation. They introduce four principal elements of a community as (1) Membership, (2) Influence, (3) Integration and Fulfilment of Needs and (4) Shared Emotional Connection. Thus it can be seen that forming communities can fulfil 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 findings. Influence is bidirectional; a member has influence over others and group has the ability to influence the member. Integration and fulfilment of needs cause to better fulfil the needs within a community. Shared emotional connections are due to past events and experiences. Thus community formation satisfies top 3 levels of human needs as well as a basis for communication.

Cova (1997) explains how the phenomenon of community also known as neo tribalism is of immense social importance in this postmodern era. He explains how desire to belong to a community makes postmodern individuals to consume products and services, which may or may not for the use value but for the linking value to community members. In this information age information has become the most powerful product or service (Kahn et al. 2002) thus exchanges within a community can take either form of product, service or information. Exchange of information, products and services fulfils some of the level 2 needs.

Formalisation of exchange of products, services or information within a community create markets. Jones et al. (1997) rationalize how markets have a formal exchange mechanism, a medium of exchange such as currency, and trust (or reputation) which is the most essential emergent characteristic (ECH) for any exchange. These exchange mechanisms need to be adaptive and responsive to meet the dynamic nature of today's market requirements. Thus by working as virtual organisations by collaborating horizontally with similar units or vertically with complementary units they can achieve a marketing edge predicted Ginige (2004). Several years later we experienced an explosion in collaborating with a new emerging exchange mechanism known as Collaborative Consumption, disrupting outdated modes of exchange and reinventing not only what we consume, but how we consume. Peer-to-peer lending like Airbnb, car sharing like Uber, while ranging enormously in scale and purpose, these organizations are redefining how goods and services are exchanged, valued, and created (Botsman and Rogers 2010). The currency or mode of exchange in these markets is Trust that emerged due to user reviews, ratings, rankings or recommendations. The level of Trust required depends on available Risk Minimisation mechanisms that used to be warranties or guaranties but that has now become reputation one builds in the digital environment, which is also transferrable among different markets. Thus we visualize below the process of fulfilling needs through community formation where emergent characteristics emerge within communities that cause action taking leading to business outcomes in a non- digital environment.

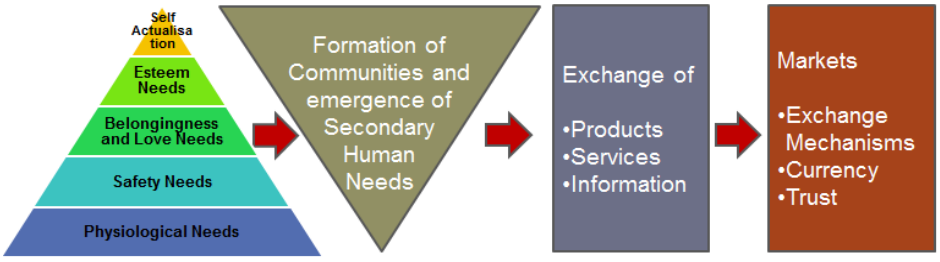

Figure 5. Fulfilling Human Needs in Non-Digital Environment

This model summarizes that to fulfil primary human needs humans form into communities. The inverse pyramid that depicts community size primarily illustrates to meet Level 1 needs very small or no community is required. But once you reach higher levels of needs to fulfil same much larger community is required. It is also noted that when humans form into communities that secondary human needs such as schooling, education, entertainment, leisure, arise (McGraw-Hill-Higher-Education 2010). It is within the community that emergent characteristic belongingness emerges first, then self-esteem, connection, engagement, trust leading to empowerment. It is these emergent characteristics that cause community members to exchange information, goods & services. Formalisation of these exchanges is what known as markets. These learnings from non-digital environments are analogous to the causal chains that we found and the generic multistage causal model we have abstracted. With this understanding of how human needs are being fulfilled in a non-digital environment we draw the conclusion that simply supporting online business transactions alone as in the eBusiness era is not sufficient. Social Computing applications should have a mechanism, the correct functionality to gives rise to the Application Characteristics (ACH) that are Content Sharing (CS), Social Interactions (SI), Business Transactions (BT) and Aggregated Knowledge (AK) to build communities, and then should support the communications and interactions within the community. This will give rise to emergent characteristics (ECH) within the users, which will lead to exchange of valuable information that can result in many other User Actions thus achieving enhanced business outcomes.

7. CONCLUSION

In our extensive analysis of data it is the specific causal chains we derived for specific scenarios that disclosed a common pattern formation amongst them that helped us abstract a generic multistage causal model for Social Computing and business outcomes. It guides us on step by step forward causal path as how emergent characteristics (ECH) trigger the users to certain specific user actions (UA) that results in enhanced business outcomes. These emergent characteristics took the form of a feeling: such as belongingness, self-esteem, connection, engagement, trust leading up to empowerment or user perceptions: such as easy to use, convenient, efficient, less costly, and the likes. Forward causal path in the model demonstrates these emergent characteristics were caused by application characteristics (ACH). This understanding sheds light that to gain a planned specific business enhancement the application characteristics (ACH) needs to be designed to give emergence to the necessary emergent characteristics (ECH). Thus we conclude that this paper is making a contribution towards two

significant business enhancements through Social Computing. First, the need fulfilment through community formation that happens in non- digital environments can now be mapped to a digital Social Computing platform thus creating communities of scale such as 60 million in Airbnb or 1.79 billion on Facebook hence achieving enhanced business outcomes of unprecedented scales. Second, the multistage causal model imparts the step by step forward process of business enhancement through Social Computing. Following the reverse process to gain a specific enhanced business outcome we now know what user actions (UA) need triggered, what emergent characteristics (ECH) will trigger these user actions and what application characteristics (ACH) will emerge required emergent characteristics (ECH). Thus with this knowledge now we can design successful Social Computing applications with necessary application characteristics (ACH) that will give rise to expected emergent characteristics (ECH) thus leading to required user actions (UA) which will cause enhanced business outcomes.

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