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Formal Theory of Use of Social Networking Sites in Academic Communication

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ABSTRACT

A social network can be represented mathematically using set theory, matrix expression, algebraic expressions, graph theory, and network theory.
In this paper, a formal theory of Global Management Educational social network system (GMESNS) is discussed. It is shown that properties and attributes of an offline social network are applicable to online social network. The logical and deductive arguments are all based on exhaustive review of literature.
Given possibility of social networking using GMESNS amongst { all management institutes ,and three types of actors namely teachers, students and alumina } it is established that one can think of exactly ten types of ties definable between the actors in the system, where the institutions themselves enter as participating actors.
Further, a model is proposed to do to a cost benefit analysis of including social networking sites in formal education, on the basis of a Social Networking System with these ten basic types of ties and all actors as above participating in it.

1.0 INTRODUCTION

Following aspects are already known and have been matter of much discussion in literature.
Social network: A social network can be represented mathematically using set theory, matrix expression, algebraic expressions, graph theory, and network theory. A Social scientist like Barabasi and Albert (1999) would define a social network as " A Finite set of actors that may have relation or relations defined on them". Given a representative network diagram, the actors are represented by the vertices, numbered as many as members in the network, and relationship between any two members is represented by edges).
There are a few measurable attributes which can be associated with any network of people. Even the strength of relationship is measurable as following evidences indicate.

1.1 Measurable attributes of a network and an actor

At macro level Analysis the magnitude an network can be expressed by the value of attributes like ***Size, Density, Diameter, Radius, Directed/undirected, connectivity etc*** are all easily definable attributes**.** Similarly at macro level analysis the quantitative measure of strength of relation of an individual acto,r in relation with other actors in the network, can be expressed by the attributes like ***Degree, Geodesic distance, Eccentricity, Reach-ability, Centrality*** etc. according to (kadushin 2007)

1.2 Mathematical Properties of Online Social network :-

a) Researchers of various disciplines specially in the field of mathematical sociology have proved certain mathematical properties of social network. Few of them are listed here. Small world effect according to (Granovetter 1973)
b) Six degree of separation according to (Hanneman, and Riddle 2005)
c) Densification power law according to Leskovec et. al 2005)
d) Scale free property accoding to (newman and Girvan 2006)
e) Network Transitivity according to . (Newman et.al 2001)
f) Community structure (McGlohon et.al 2011)
g) Homophile according to (Musiał, and Kazienko, 2013)
h) Strength of week ties as per (Travers et.al 1969)

When it comes to people, who are not geographical bound to a small area but are connected to each other through devices and support like internet, we get a natural extension of above concepts

1.3. Online social network

An online social network is a finite set of actors. The relationship is defined on them is by means of different services (S1,S2, ---- -Sn) available and provided on INTERNET. Presence of a connecting edge assures that these services are active between the actors. Examples of online social network include People connected with emails, forums, blogs, social networking sites etc

1.4 Difference between online and offline social network

Every online social network is a social network too, hence all the properties of any social network, which we discussed earlier , is also applicable to online social network. An online social network gives a few extra properties, few of them are discussed below

Physical or Personal in contact between actors(i and j) at least once is required in offline social network, for a tie tij to be established. In other words actor i and j should be present at same time t at same place p for establishment of tie. In offline social network the actors are not necessary

1.5 Characteristics of online Social networking Sites

- OSNS can be used to mainain Offline Social Network , or to create Exclusive online social network.
- An actor A becomes a member of social networking site G by creating its iid by filling profile information.
- A then receives from or send to other members of G an invitation to form a tie. if invitation is accepted a tie is formed (Friending).
- Bidirectional Tie is called friend and unidirectional is called a fan or a follower.
- A unique features of social networking site is the all ties of an actor are visible. It is called as list of friend or contacts. some social networking sites creates shortest Geodesic distance between the actors.
- A social networking sites is used for maintaining strong as well as week ties. The strength of week is also applicable on online social networking sites.
- The size of online social networking sites (OSNS) is very high. (Facebook- 1550 Milian Users)
- Some actors in online social networks have very high in and out degree
- to be present at same place at some tie for established or continued
- The physical distance PD between two actors(i and j) can be very long. (0 < PD < infinity) it can be any value between 0 and infinity.
- There exist an unambiguous and reliable correlation between an actor's online social network identity and their real identity in real word. (i -> i's)
- The simplicity of a break up and suspension of contacts or relationships.
- The relatively high ease of gathering data about communication or common activities and its further processing.
- Potential lower reliability of the data about users available on the Internet. Users of internet services (Wasserman 1994)

Once you are on the online environment , online networking site becomes an essential phrase and a concept, to be defined and properly understood

1.6 Online Social Networking Site

An online social networking site, can formally be defined as " An online social network X which has finite set of actors and ties between the actors. Each actor is represented by an electronically defined identification idd. Each idd has a corresponding user's profile. This user profile gives some amount of important information about the real actor."

Online social networking sites (OSNS) is a subset of online social network and which in turn is a subset of social network, all the properties of social network and online social network are inherited by OSNS. For eg small world phenomena, densification power law etc.

2 Proposed formal-mathematical model of GMESNS

2.1 Definition of the Model

Let G be a set online social networking sites G ={G1,G2_ _ _ _ Gn},
Let S be the set of students of Management institutes
S = {S1, S2, _ _ _ Sn},
Let T be the set of Teachers of Management Institute T = { T1,T2, _ _ _ Tn},
Let M be the set of Management Institutes
M = { M1,M2, _ _ _ Mn},
then, GMESNS , is a global model , which may exist in one of the following forms, specifically described in Case I and Case II below.

Case I: Teachers T, students S can join one or more sites of G, by creating their profiles on the site, however this will be limited to few popular sites not all. Management Institute as artificial persona can join selective members of G by creating institute-profiles, exactly like any individual creates his own profile.

Case II: The Student SjMi the students of Management institute Mi connects with another SkMi of Management Institute Mi in Social networking site g of G. They are joined by others and community(CsMi) of student of Mi is created in g. There are n students in csmi who are connected with strong ties and most of them have similar characteristic (homophily). This process is replicating the real social network (canteen, class room, common habits, studying same subject in virtual space). There can be several communities of students (CsMi1, CsMi2, CsMi3---------- CsMin) in g. cliques or clans or communities of students are formed in g.

Similarly teachers T= {t1,t2,t3_ _ _ tn} will join g by creating their profile in g. similarly there can be several communities of teachers of Mi will be formed in g. There can be 1 to n communities (CtMi1,CtMi2 _ _ _ _ CtMin) of teachers of Mi in g. There will be strong ties between the all teachers of a community. A student sj of CsMi1will be connected to another student Sk of CsMi2 through a week tie, similarly there can exist week ties between teachers of different communities i.e CtMi1 connected to CtMi2. There will be in communities of students communities of teacher where M can be very compared to M, even it can be 0 or 1. There exist week ties or structural holes or bridges between students of different institutes(Mi and Mj) i.e. SjMi is connected to SkMj and teachers of different institute TjMi is connected to TkMj in g of G. As supported by(Gartner 1973) any new information or valuable information will come from this week tie. The flow of information regarding placement drives, examinations, workshop will flow between institutes through this week ties.

There is a possibilities of existence of tie between the n students of Mi with 1 or m teachers of Mi in g of G. [For the purpose of discussion we assume this tie to be formal, professional & academic instead of free and informal].

All teachers of Mi and all students of Mi are connected with Mi in g. This tie or link is unidirectional. There will be frequent flow of Huge information between Mi and T, as well Mi and S in g.

Although social networking sites are noisy communication channel where formal as well as informal information flows. It is the source of authentic news as well as rumors. As flow of information Mi will always tend to be authentic & formal like news broadcast or notice board. The use of g by Mi as formal mean of communication will increase probability of it reaching maximum number of people.

Yet another but a rare possibility is of existing of a tie between teacher tkMi of institute Mi with student SjMk of institute Mk, but this type of link will rarely exist as will another type of link may not be very useful

The ties in G can be classified into 10 categories as follows

Sr	Tie	Description	Nature
1	$S_jM_iC1 \leftrightarrow S_kM_iC1$	Tie between homophilious students of same institute (homophily - same community)	Strong tie
2	$S_jM_iC1 \leftrightarrow S_kM_iC2$	Student of same institute of different community	Weak tie
3	$S_jM_iC1 \leftrightarrow S_kM_jC2$	Students of different institutes	Weak tie (but important)
4	$S_jM_i \leftrightarrow T_kM_i$	Student and teachers of a institute	Strong but formal tie.(can useful for flow academic information)
5	$T_jM_iC1 \leftrightarrow T_kM_iC1$	Tie between the teachers of same community in same institute	Strong tie
6	$T_jM_iC1 \leftrightarrow T_kM_iC2$	Teachers of same institute of different community	Weak tie
7	$T_jM_iC1 \leftrightarrow T_kM_jC2$	Teachers of different institute	Weak tie
8	$S_jM_i \leftrightarrow T_kM_j$	Teacher of one institute with student of another institute	Rarely exist (is not useful as S_j is not the student of T_k)
9	$S_jM_i \leftrightarrow M_i$	Students with institute	Formal, strong and temporary
10	$TjM_i \leftrightarrow Mi$	Teachers with the institute	Formal and strong

Table 1 categories of Ties

Let us consider a CSMi be a community or group of communities of students of Mi

graduating in year y. As soon as they graduate they cease to be student (they are no longer student). However on graduating they will be Alumina of institute of Mi of batch y. Thus the CSMi will be renamed as AyMi in g. This group will be connected with a week tie with Mi. The Alumni institute tie will be an important tie which is difficult to maintain using traditional medium. Hence it is important tie in g.

Consider a member AyjMi can join institue Mi as teacher, this member can an important link or bridge or a structural hole between the institute and the alumina. The week tie between the alumina and institute will be a great resources. It will provide resources for various activities like guest lecture, training, mentoring, Apprenticeship, placement, corporate relations.

3.0 COST BENEFIT ANALYSIS OF USING SNS IN ACADEMICS

In any system adoption of a policy would cost , to the constituent members of the system though may not be always in monitory terms . Hence there will always be comparative priorities The dependency of the priority can be expressed as:

SNS adoption priority = f(cost, benefit, risk-current_system, risk-proposed_system, risk-adoption) *(1)*

Given the current situation of infrastructure availability and freedom available on the world wide web, we make the following assumption.

First assumption: A small affordable and negligible cost is associated with the adoption, if implemented using the current infrastructure, and hence ***Cost = C = 0*** ***(****Current users are Teachers and students, Alumini, NO replacements of current system is needed)*

In reality, C is not zero but very small, for all practical purposes we set C=0, which amounts to saying that none of the actors, need to spend any significant amount . Which is a happy situation and Management Institutions who would be significantly important participants do not have to think of Cost as a prohibitive factor. So the analysis reduces to following equations:

Using the notations P = SNS adoption priority; B = Benefits; R = Risks , equation reduces
P=f(B,R) (2)
The risk and benefits can be referred as problems and prospects, and one may naturally expect the following laws to hold.
P

$$P \propto B \quad (3)$$

$$\text{and} \quad P \propto \frac{1}{R} \quad (4)$$

$$\therefore P = K \frac{B}{R}$$

where K is a Constant ***(5)***

3. 1 Benefit in Education (B1)

Before the adoption of the *new (social networking) policy*, status of a student will be at an initial state given by

$Std_0 = \{K_0, A_0, S_0\}$ …… (6**)**

Where **Std** = A numerical scale indicating state of a Student

K_0 = Initial Level of Knowledge,

A_0 = Initial Attitude,**S_0** = Skills

After Completion of formal education in Time **T**, with active implementation of the policy the positive change due to benefits would be

$K_T = K_0 + \partial k$, $A_T = A_0 + \partial a$ and $S_T = S_0 + \partial s$

∂k = Increase in Knowledge ,∂a = Change in Attitude,∂s= Development in Skills

$$\therefore \gamma = \partial k + \partial a + \partial s \quad \textbf{.(7)}$$

Where ∂ *is between 0 and* ∞

$\therefore Std_T = Std_0 + \gamma$

$E \propto \gamma$ (**E** is Employability)

Institute adopts SNS, hence

$\gamma_{SNS} = \gamma + \partial\gamma$ **(8)**

(where $\partial\gamma$ =Additional Gain).

Hence, the probability of E will increase and We can say that

B1 = $\partial\gamma$ *(9)*

$\partial\gamma$ is an effective measure of benefit

Similar arguments can be put forth in favor of benefits in communication

3. 2 Benefit in Communication (B2)

If the information reaches M members in time T using traditional medium, it will be reach (M+ ∂**m**) in time (T- ∂t). Thus there will be a benefit dm/dt by using social networking sites g as addition medium without replacing existing mediums. The information will reach maximum people in less time,it

Will also reach to those isolated members who would have not get this information using traditional ways.

B2 = M + ∂m / T - ∂t, …… ***(10)***

M= Members, ∂**m**= Change in No. of Members **T** = time ∂t =Change in Time

hence their Prospects(enormous benefit) in using this system.

However there some problem, but it can be argued that the problems can be reduced or its intensity can be minimized.

4.0 CONCLUSIONS:

We have effectively argued that, a mathematical theory of online social networking sites of exclusive management students is possible. Reliable cost benefit analysis can be based on this theory

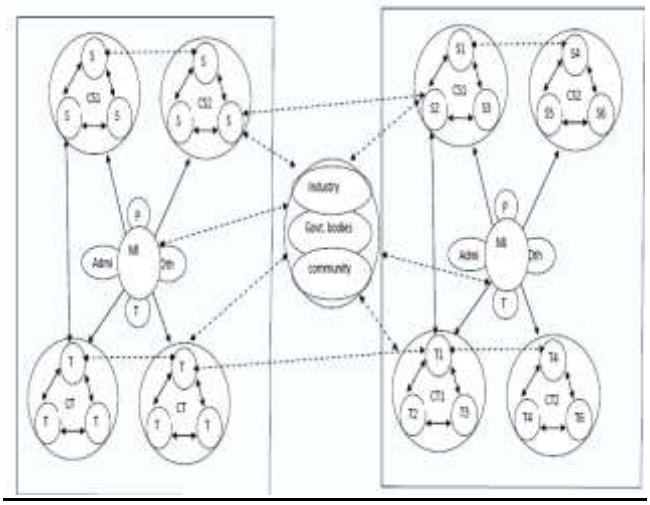

Figure 1:proposed model of communication

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