Exploring Viral Phenomenon as an Innovative Trajectory

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Abstract--**The viral phenomenon has garnered a great deal of attention in the recent years. Although evidence of viral success exists the underlying factors leading to the phenomenon and its measurement still remains a grey area which needs to be explored. The viral phenomenon for a product or information and its distinction based on growth curve trajectory has not been rigorously explored in the previous works. This paper aims to understand the viral phenomenon that makes products or information go viral. The viral phenomenon trajectories that distinguish the viral from a non-viral phenomenon are demonstrated. The curve fitting methodology for viral phenomenon is adopted which has not been looked into in the previous works. TED talks are analyzed to understand the diffusion pattern, essentially one or more spike, within a time period. Insights drawn indicate the characteristic viral growth trajectories and its implication on innovation.**

I. INTRODUCTION

The study of viral phenomenon has exceeded biological metaphors. Today, we have collectively accepted that the mention of viral market penetration could be a reference to a product, technology, information, an event or an idea. The understanding and application of viral as a phenomenon in diverse fields offers immense opportunities for product designers. The objective of this paper is to identify if a product or information exhibits a characteristic growth pattern thus, distinguishing it as a viral from a non-viral phenomenon. In doing so, we offer two contributions. First, the identified viral phenomenon function was empirically demonstrated with our data set to distinguish the viral from a non-viral phenomenon. Second, we developed a viral phenomenon trajectory that represents the different scenarios of viral phenomenon. This paper is organized as follows: The paper commences with the previous literature to understand the dynamics pertaining to viral phenomenon. This is followed by research methodology which explains the approach we used. We then describe our modelling approach, present our empirical analysis and findings of the data.

II. LITERATURE REVIEW

A review of literature shows a limited consensus on the understanding of viral phenomenon. The viral phenomenon must be seen as multi-disciplinary spanning over disciplines of Sociology, Psychology and Economics [12]. The earliest mention of the term 'viral' to describe the epidemic spread beyond the significance of biological and digital virus was in the field of marketing [15], [27]. The term viral with respect to marketing was coined by Steve Jurvetson and Tim Draper from the venture capital firm Draper Fisher Juvertson (DFJ) in 1997 [23], [24], [12], [16]. The earliest usage and popularization of the term viral marketing (v-marketing) can be attributed to Jeffrey Rayport in 1997 [27], [13]. The viral phenomenon can be viewed from diverse dimensionality and therefore the literature review is structured based on the following factors.

A. Rate of adoption and penetration

The rate of adoption and penetration refers to the speed at which an innovation is adopted and spread by the members of a social system [28]. Rapid communication can manifest itself in a number of forms like e-mails, mobile phones, websites, blogs, newsletters, social networks, picture, text, viral videos and audios, there by posing challenges to the measurement of viral phenomenon [7], [12]. Gartner's hype cycle affirms that technologies do not move at a uniform speed through the cycle and the time-to-maturity assessment is based on three adoption speeds: "Fast-track", "Long-fuse" and "Normal" technologies [20]. The real effectiveness of viral penetration is being able to measure the multiplier effect, i.e., measuring the information cascade not only at the first level, but also at all subsequent levels [7], [25], [23].

B. Word-of-mouth (WOM)

The diffusion of a product or information, triggered by word-of-mouth (WOM), is a major factor for a viral phenomenon. People like to share their experiences with others and more often so ask others for recommendations, leading to a snowball of recommendations [8], [23]. Word-of-mouth is viewed as one of the modes of communication in the communication mix [18], [7]. It is defined as "People-to-people oral, written, or electronic communications that relate to the merits or experiences of purchasing or using products or services" [18]. The WOM leverages personal communication channels which consist of friends, family members and neighbors to influence consumer attitudes [4]. Although the integration of mass communication channels stimulates personal communication the influence follows a "trickle-down" effect. The earliest adopters of WOM techniques was corporate giant Procter and Gamble (P&G) with its launch of Tremor (2001) and Vocalpoint (2005), as a vehicle to market products to teens and "connectors moms" respectively, [10], [1]. The advent of internet has changed the concept of WOM [12]. Viral marketing (VM) is mostly viewed as an electronic form of WOM (eWOM) [7], [24]. Juvertson and Draper called their model viral marketing referring to Hotmails blazing growth because of "the pattern of rapid adoption through word-of-mouth networks" [15]. The proliferation of internet technology and its concomitants like social networks, emails, video-sharing sites, websites, blogs and instant-messaging have enabled people to have

more opportunities to talk and share their experiences at the speed of thought [10], [12].

C. Built-in trigger

The best viral triggers are built into the product itself, for example: i-Zone camera from Polaroid [29] and Hotmail [8], [12], [24], [15]. Hotmail grew a subscription of over 12 million subscribers within 1.5 years of the company launch while spending less than $500K on marketing, advertising and promotion [6]. An advertising message "Get your free mail at Hotmail" was appended to every outbound email thus, each new user became the company's salesperson and spreading the message organically [15], [8], [12], [24]. The 'Stickiness factor' creates a memorable and irresistible message impact [11]. The uniqueness of the content or product [24], (be it in look, functionality, ease of use, efficacy, or price) and high visibility are the two criteria which leads to a product going viral [8]. In the viral growth phase, the critical differentiator in the viral strategy is whether the company has built in barriers to switching for its customers and barriers to entry for its competitors. A huge variable in the rapid growth will be the customer retention rate [15].

D. Social contagion and networks

The viral phenomenon takes advantage of collective intelligence network. Herding phenomenon has a broad application, from fashion, mob violence, stock market bubbles to consumer preferences, therefore a potential dimension to our study of viral phenomenon. The analogy between the patterns of flocking in animals and humans leads us to the fundamental reason for sharing information in ravens, bees, and in ants and this is not very different from the reason we talk [9]. Herding could be closely connected with crowd behavior [2] and group-think. The interactions between people, institutions and markets determine collective social behaviour [31]. An integrated approach to herding addressed the two key factors namely, the mechanisms of transmission of thoughts or behavior between agents, and the patterns of connections between agents [26]. The small-world problem experiment conducted by the Psychologist Stanley Milgram provides an understanding of how human beings are connected through an interlocking web leading to a social network analysis [22], [17]. Social structures evolve in time and are multiplex, where people maintain a portfolio of types of ties with each serving different functions [31]. The viral phenomenon thrives on weak ties where individuals with many casual social connections have a larger influence on communities than do with individuals with fewer strong connections [27]. For example companies such as Tupperware and Amway have leveraged such ties to sell their products and services [27]. Although the information flow will be rapid among strong ties but the existence of some "heterophilous" relationships is the prerequisite for the diffusion of new information [21]. The viral phenomenon defines the importance of messenger and the message content. The success of viral effect as a social epidemic is heavily dependent on targeting and impacting the right set of people who are critical in influencing and spreading information [11], [23], [17]. In social structures, people interact and their interactions have consequences for the choices they and others, make [31]. The 'law of the few' identifies three kinds of people called, Mavens, Connectors, and Salesmen, who play a critical epidemics cascading role [11]. An array of terminologies used to describe and classify opinion leaders or the people who spread viral messages are: "super spreaders", "super e-mailers", "sneezers", "nutters", "influentials and influencers", "efluentials" [7]. The impact of opinion leaders follows the 80/20 principle [11], [17]. The viral model looks for the 20% from prolific hosts, potential affinity groups or opinion leaders, and tie to their high-frequency social interactions. It taps into the breadth of its customer's weak connections to others [15], [23], [19]. The viral phenomenon provides a new distribution channel by lending itself to free communications or network applications where the customer would be treated like a distribution partner. In the pyramid scheme through word-of-mouth promotions, the customer would not only help resell product but would also innovate and discover new distribution networks which are called self-organizing viral distribution networks [27].

E. Threshold and Inflection point

In the viral broadcast model the value of network increases disproportionately as more people join the network [15]. Viruses do not become epidemic until they reach the tipping point. Therefore, the virus must expand through the host population until it reaches a certain threshold of visibility and scale [27]. This phenomenon is referred to as the tipping point, where ideas, products, messages or behaviours cross the threshold and spread as epidemics [11].

F. Innovation trajectory

The technology trajectory integrates technological issues into business decision making to achieve a balance between market pull and technology push [6]. Christensen explores with the aid of performance trajectories on how to assess technologies and designed rules to maximize the success of disruptive technologies [27], [5]. The 'fast-track' technologies have a rapid transition and adoption rate with the performance curve inflecting early [20] and can be considered as a potential dimension exhibiting viral characteristic at the initial phase.

The literature review helps in understanding the existence of a phenomenon called viral phenomenon and its underlying factors. It can be summarized from the literature that a rapid market penetration of a product or information is termed as going viral but notable gap exists in quantitatively distinguishing the viral from a non-viral phenomenon. Our study aims in understanding the characteristic viral growth trajectory and distinguishing the viral from a non-viral phenomenon.

III. RESEARCH METHODOLOGY

The research methodology uses curve fitting research method to analyse the characteristic growth pattern and to understand how certain dimensions shape the viral nature of outcome variables.

A. Defining viral phenomenon

We build our definition of viral phenomenon based on the definition of Rogers [28] and Hemsley [14]. The two key factors that define viral phenomenon are the process of product or information disseminating in the population i.e., maximum number of people being exposed and adopting the product or information, and, the time rate (speed) at which the diffusion happens among the population. The viral phenomenon is a representative of a growth curve. The distinctive feature of viral phenomenon which differentiates it from other forms of growth curves is the function of time. The viral phenomenon is a special case of diffusion with the element of speed, i.e., the rate of change or the time factor of product or information diffusion in networks. The trajectory of growth rate for a viral phenomenon follows an exponential relationship.

A viral growth curve based on periodic growth trend could be deconstructed into following phases namely, growth spike, plateau and decay. The growth spike refers to the peaks during the entire phase of the product or information lifecycle. The plateau represents an equilibrium growth state. The decay or dip refers to the declining growth trend. To be defined as viral, the growth spike should be at the maximum during the lifecycle or for the period of study.

B. TED Talks

We analysed TED talk videos to understand the viral phenomenon for information. The TED talks hosted at TED conferences are released online on the TED website, www.ted.com.

Data: The daily information of all the TED talk videos that appeared on the TED webpage (www.ted.com) was collected. The data was collected between 18 November 2013 and 21 January 2014 which amounts to a period of 65 days.

The following information for each talk was recorded daily (day-on-day):

- Title of each TED talk
- Speaker name for each talk
- Event location of the TED conference where the talk was held
- Date posted i.e., the month in which the talk is posted on the TED webpage
- Number of views for the talk
- Number of comments for the talk

The sample consists of 34 TED talks. The number of views on day 1 was recorded with subsequent daily tracking of number of views on consequent days. Views on day 1 signify the number of views for the date on which the talk is posted.

IV. ANALYSES AND FINDINGS

A two-stage analysis is conducted. The first stage involves the process of identifying a viral phenomenon mathematical function. The second stage involves the curve fitting method and presenting the results with respect to the viral phenomenon function. The second stage consists of outlier identification and identifying viral phenomenon trajectory for TED talks. The process of identifying the viral phenomenon trajectory is three-fold and involves growth spike analyses, distinguishing the TED talks that follow viral phenomenon trajectory from a non-viral trajectory and determining the viral threshold point.

A. Determining viral phenomenon function

The earliest mention of the term 'viral' to describe the epidemic spread in other fields of study drew its inspiration from the field of biology as mentioned earlier in [15], [27]. It was based on the speed of pattern of virus spread. We draw inspiration from the pattern of epidemic spread to study viral phenomenon with respect to product and information diffusion. Therefore, the field of epidemiology dealing with the spread of epidemics and infectiousness is used as a basis for identifying a mathematical function to study viral phenomenon. The viral transmission is analysed by growth curves. The rapid growth for an epidemic spread is modelled as an exponential process as mentioned in [16], [30], [14] and given in (1). The adopted model which gives the exponential growth phase for viral phenomenon is given by,

$$V(t) = V_{(0)}\, e^{\beta t} \qquad .....(1)$$

where, V = value at time 't'
$V_{(0)}$ = value at the start
β = rate of growth
t = time

This model is evaluated using daily views data. Equation (1) verifies whether the viral phenomenon follows an exponential growth curve. This is compared with three other growth curve models namely, linear, S and logarithmic. We assessed which growth curve model achieved a closer fit and thus distinguished if a particular TED talk followed a viral or a non-viral growth.

B. TED talk analyses using curve fitting method

Our analyses focuses on the TED talk videos hosted on the website. The analysis involves identification of outlier TED talk videos from the sample of 34 talks and then classifying the outliers.

1) Outlier detection: The growth spike through the lifecycle for each TED talk based on number of views can be ascertained only by tracking the talks from the day the talk is posted on the TED website. The number of views on day posted (day 1) of all the TED talks that was posted on the TED webpage was collected. A scatter plot consists of the

data set of 34 talks with the variables containing unique TED talk ID (which represents talk title and the associated speaker name) and the cumulative views. The identified outliers in the scatter plot is represented in Fig. 1.

Two factors namely, the maximum delta (Δ) value for views and maximum cumulative number of views are identified for each talk. The delta (Δ) value for views per each day and per each talk is calculated. The delta (Δ) value for views represents the change in the number of views for each day and is calculated as given below,

$$\text{Delta } (\Delta)_n = (\text{Number of views for day n}) - (\text{Number of views for day (n-1)}) \quad \ldots\ldots \quad (2)$$

Example: Delta for day 4 views = Number of views on day 4 – Number of views on day 3

Six outliers are identified. The identification is based on a group analysis where a talk is identified as an outlier in comparison with other talks in the group. The details of the six outlier TED talks are mentioned in Table. I. Table. I provides the summary statistics for the posted day views, maximum views and cumulative number of views for the TED talk videos in our data set. The 'posted day views' refers to the number of views on the day the talk was posted on the website i.e., day 1 views. The 'peak views' refers to the maximum daily views reached for each talk. The 'cumulative views' refers to the total number of views for each TED talk video accumulated over a time period since the date of video posting and as on 21 January 2014.

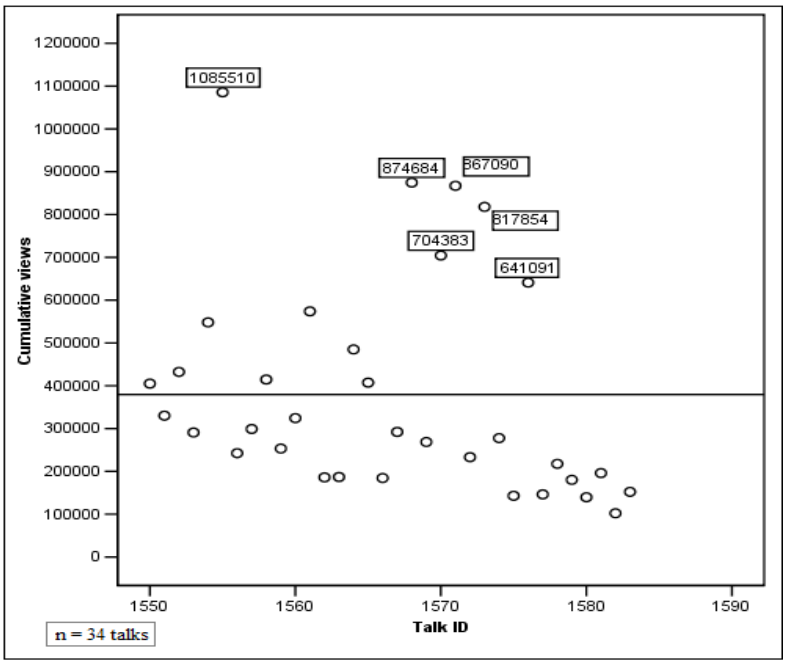

Fig. 1. Outlier detection for TED talks

TABLE. I. SUMMARY STATISTICS FOR THE OUTLIER TED TALK VIDEOS

Talk ID	Speaker	Talk title	Talk posted date	Posted day views	Peaks-maximum number of views	Cumulative views
1576	Sandra Aamodt	Why dieting doesn't usually work	9 January 2014	69,907	164,212 (Day 2)	641,091 (Day 13)
1573	Maysoon Zayid	I got 99 problems... palsy is just one	4 January 2014	74,898	157,093 (Day 2)	817,854 (Day 18)
1571	Diana Nyad	Never, ever give up	24 December 2013	32,021	70,546 (Day 2)	867,090 (Day 29)
1570	Paul Piff	Does money make you mean?	21 December 2013	35,924	85,668 (Day 2)	704,383 (Day 33)
1568	Andrew Solomon	Depression, the secret we share	19 December 2013	32,933	197,301 (Day 35)	874,684 (Day 35)
1555	David-Steindl-Rast	Want to be happy? Be grateful	28 November 2013	95,437	104,213 (Day 5)	1,085,510 (Day 56)

2) Identifying viral phenomenon trajectory for TED talks: Two plots are constructed for each TED talk, a daily-views plot and a cumulative-views plot. A daily-views plot is plotted against time on a daily basis (e.g. day1, day 2,....,dayn) on x-axis and number of each day views (Δ number of views) for the talk on y-axis. The daily growth trend for the six outlier TED talks are represented in Fig. 2, Fig. 4, Fig. 6, Fig. 8, Fig. 10 and Fig. 12. For cumulative-views plot, a curve is plotted to the series of data points. The curves are constructed for the identified outliers based on the cumulative number of views. The x-axis contains time period in days i.e., days of viewing (e.g. day1, day 2,....,dayn). The dependent variable plotted on y-axis contains the value for cumulative number of views. The cumulative views plot for the six outlier TED talks are represented in Fig. 3, Fig. 5, Fig. 7, Fig. 9, Fig. 11 and Fig. 13.

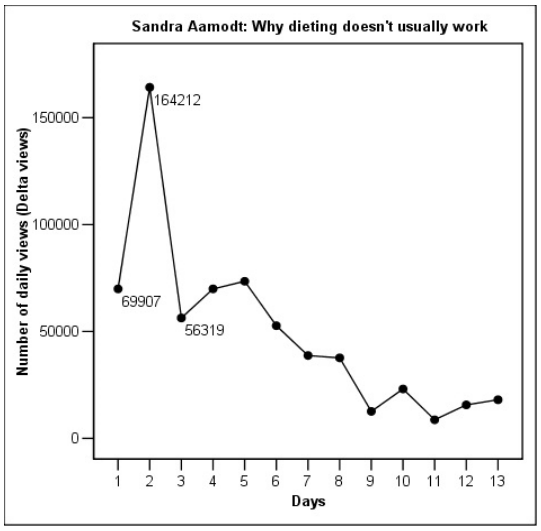

Fig. 2 Daily growth trend for TED talk of Sandra Aamodt (Talk ID 1576)

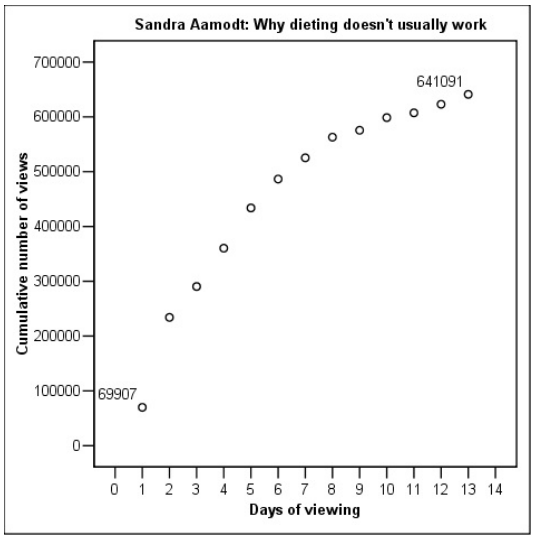

Fig. 3 Curve fit for TED talk of Sandra Aamodt (Talk ID 1576)

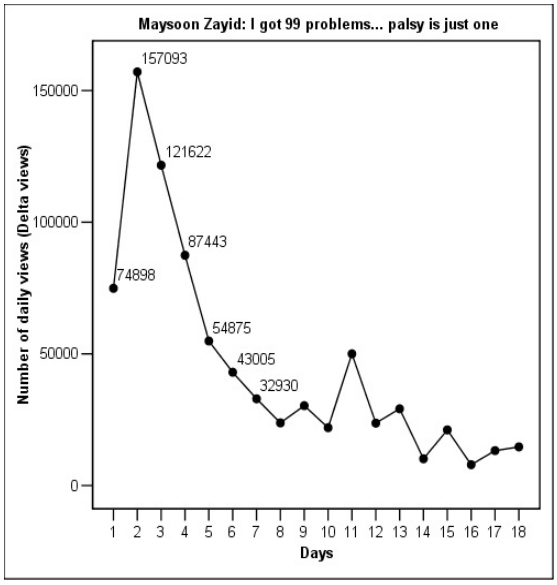

Fig. 4 Daily growth trend for TED talk of Maysoon Zayid (Talk ID 1573)

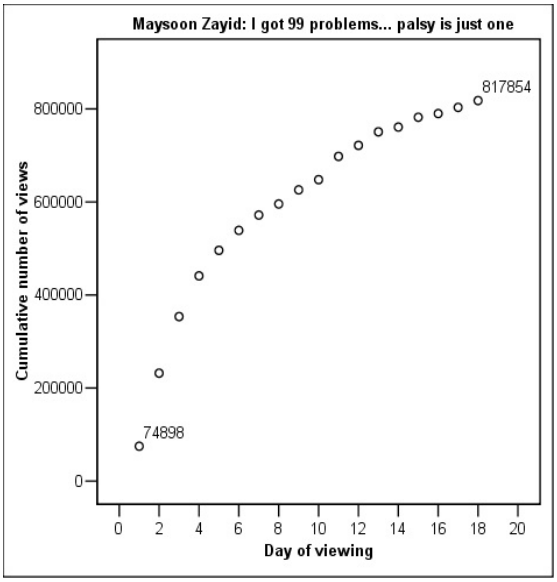

Fig. 5 Curve fit for TED talk of Maysoon Zayid (Talk ID 1573)

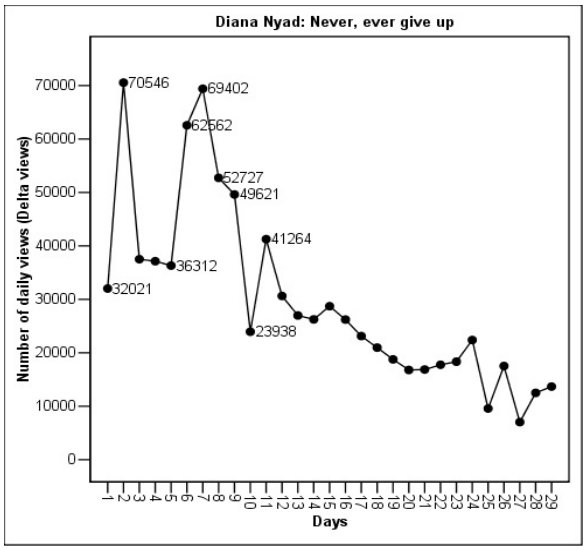

Fig. 6 Daily growth trend for TED talk of Diana Nyad (Talk ID 1571)

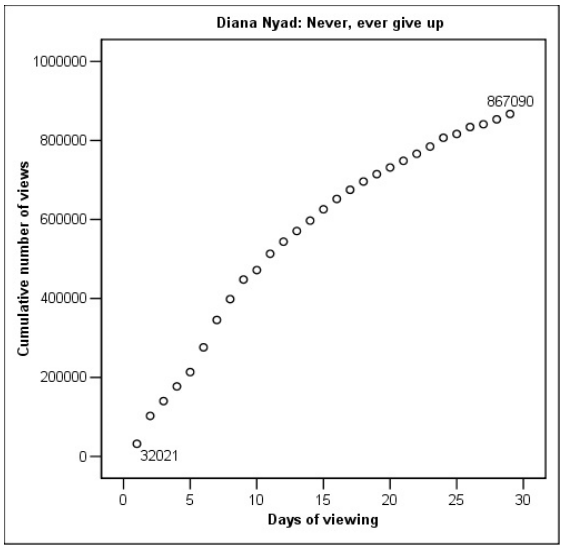

Fig. 7 Curve fit for TED talk of Diana Nyad (Talk ID 1571)

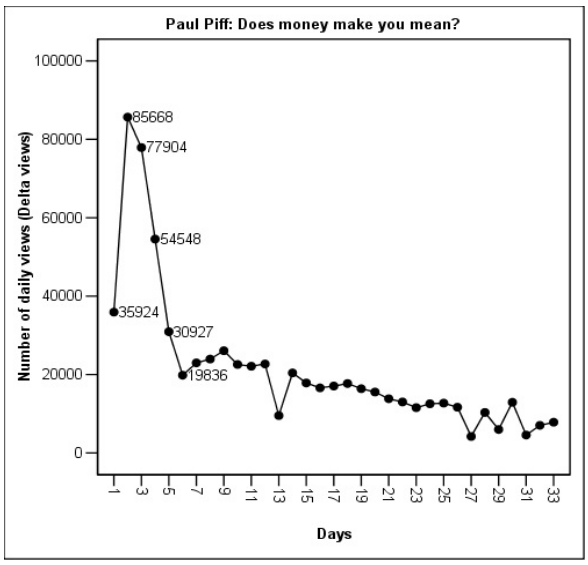

Fig. 8 Daily growth trend for TED talk of Paul Piff (Talk ID 1570)

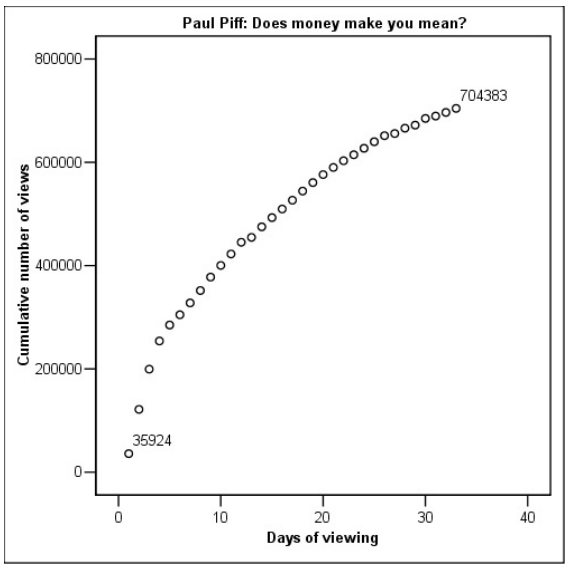

Fig. 9 Curve fit for TED talk of Paul Piff (Talk ID 1570)

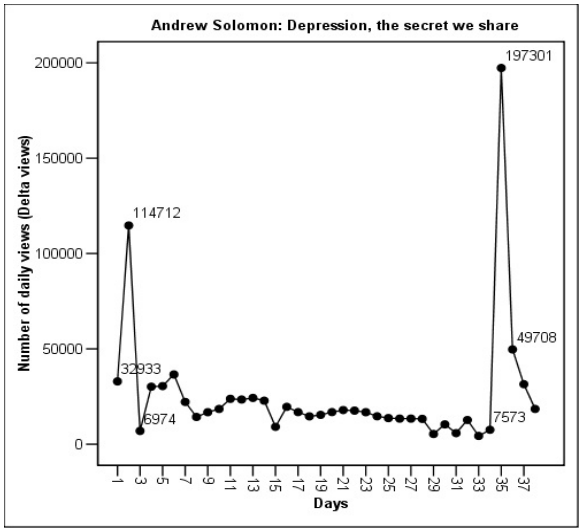

Fig. 10 Daily growth trend for TED talk of Andrew Solomon (Talk ID 1568)

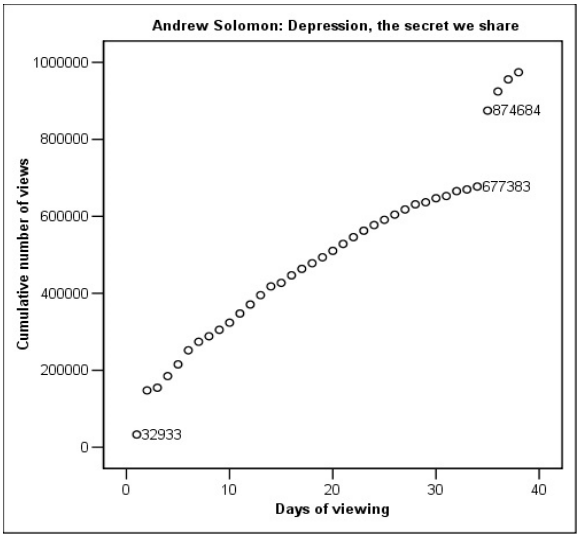

Fig. 11 Curve fit for TED talk of Andrew Solomon (Talk ID 1568)

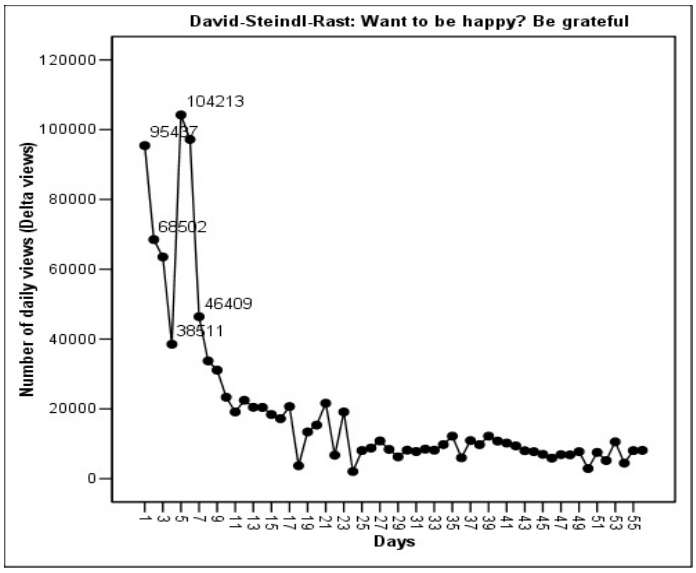

Fig. 12 Daily growth trend for TED talk of David-Steindl-Rast (Talk ID 1555)

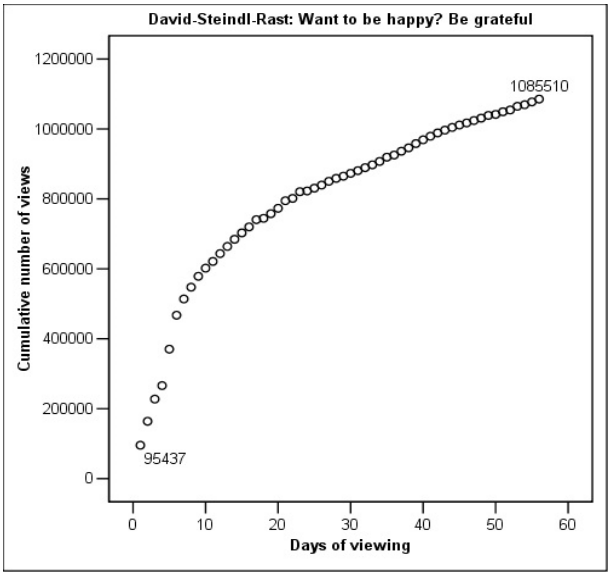

Fig. 13 Curve fit for TED talk of David-Steindl-Rast (Talk ID 1555)

The curve fitting process helps in identifying if the diffusion of the TED talk followed a viral or a non-viral growth. The distinction is based on two parameters namely, R^2 (R squared) value and MSE (mean squared error) value. The curve fit process yields coefficient of determination, an R^2 (R squared) value. The R^2 value indicates how well the data points fits the curve. The R^2 value ranges from 0 to 1. A higher R^2 value indicates a closer fit to the model and the curve. Four growth models namely, linear, S, logarithmic and exponential were applied to the data set. Equation (1) mentions that the viral phenomenon should follow an exponential growth phase. The different models of curve fit for each outlier TED talk in comparison with exponential model is represented in Table. II. The curve fit is quantified using R^2 (R squared) value. The goodness-of-fit of the model is reported by MSE (mean squared error) value. The MSE refers to the vertical distance between the data points and the generated curve. The value of Y, i.e., number of views is a huge value and progressively increases with the timeframe. This kind of data tends to give undue weight to the points with large Y values and ignores points with low Y values. Therefore, to prevent this the values of Y is transformed by dividing all the Y values by a constant. This does not change the best-fit curve as mentioned in [13]. Transforming prevents Y values from being very high and makes the units more convenient. This Y value transformation is applied for all the TED talks in our data set. In this way the MSEs of the different models for all the outlier talks could be compared on a equivalent unit basis. A lower residual mean squared error value indicates a lesser error for the curve fit. We evaluate the TED talks for a closer curve fit with the combined values of higher R^2 and lower MSE value.

2.a) Growth spike analyses: The rate of change for the viral phenomenon is defined by the growth spike. To be defined as viral, the growth spike should be at the maximum during the lifecycle or for the period of study. The positive slope gives the increasing trend i.e., the rise in peak and the negative slope gives the decreasing trend i.e., fall in the peak. The inflection point for the talk of 'Sandra Aamodt: Why dieting doesn't usually work' with 'talk ID 1576' was observed on day 2 of posting of the video. This is observed from Fig. 2 and also from the column 'Peaks-maximum number of views' from Table. I. The number of views for the talk follows a decline trend after reaching the inflection point. Similarly, TED talks with 'talk ID 1573' (represented in Fig. 4) and 'talk ID 1570' (represented in Fig. 8) follow a similar growth trend. The videos rapidly reach a peak of daily views on the day of posting or within first few days of the video posting on the website. After the initial growth phase the number of daily views begin to follow a decline trend. This can be attributed to the saturation of internet viewers in the interest network group i.e., homophilous and heterophilous ties in the network. The remaining three TED talk videos with 'talk ID 1571' (represented in Fig. 6), 'talk ID 1568' (represented in Fig. 10) and 'talk ID 1555' (represented in Fig. 12), experience two major growth spikes. The major growth spikes for the talks could get triggered at any time interval. For example, The TED talk of 'Andrew Solomon: Depression, the secret we share' with 'talk ID 1568' shows two major peaks (day 2 and day 35) during the period of study. The maximum peak is reached on day 35 as depicted in Fig: 10 and from the column 'Peaks-maximum number of views' from Table. I. Therefore, it can be inferred that the multiple growth spike could get triggered at different stages during the lifecycle of the talk.

The trend of views for six days of time period capturing the growth phase and the inflection point is our data points of interest and these are considered for further analysis. The lack of significance in the fit of the regression line to the data is increased if all the data is used i.e., all the days of viewing

for each talk. Therefore, it is important to restrict the analysis to the growth phase of the curve as mentioned in [30]. A curve fit is performed to capture the exponential pattern for the section of identified data points. The identified outliers and the corresponding curve fit R2 and MSE value for the growth phase of TED talks is shown in Table II. The viral phenomenon trajectory for TED talks is evaluated for a closer curve fit using the combined values of higher R2 and lower MSE value. The results which distinguish a viral from a non-viral phenomenon is based on a comparison with other growth models (linear, S, logarithmic and exponential) and also with other talks in the group.

2. b) TED talks following non-viral phenomenon trajectories: It is observed from Table. II that the S model for the talks 'talk ID 1576' (represented in Fig. 3), 'talk ID 1573' (represented in Fig. 5) and 'talk ID 1570' (represented in Fig. 9), has a combination of higher R2 value while maintaining a lower MSE value. The above mentioned talks does not follow an exponential growth phase as mentioned in (1). The above talks does not follow a viral growth trajectory and therefore cannot be categorized as following viral phenomenon.

2. c) TED talks following viral phenomenon trajectories: *The TED talks with higher values of R2 and lower MSE value obtained by fitting an exponential model to the data points is taken into consideration for further analysis. As observed from Table. II, the TED talk with 'talk ID 1571' displays two inflection points. The inflection point 1 of the talk follows the S model. For inflection point 2, the highest R2 value also yields a very large MSE value. Therefore, logarithm model is rejected. The linear model is also rejected for similar reasons. Therefore, as observed from Table. II, the TED talk with 'talk ID 1571' (represented in Fig. 7) consisting of inflection point 2, follows an exponential growth phase in comparison with other growth models. Similarly, the TED talk with 'talk ID 1568' (represented in Fig. 11) consisting of inflection point 2, also follows an exponential growth phase in comparison with other growth models. As observed from Table. II, amongst the group of outlier TED talks, the TED talk video with 'talk ID 1555' indicate a closer* exponential curve fit (higher R^2 value closest to 1 and lower MSE value nearing 0) in comparison with the other talks in the identified outliers group. The exponential curve fit for 'talk ID 1555' is represented in Fig. 14. It follows the exponential growth phase and thus categorized as following the viral phenomenon trajectory. The pattern of exponential growth phase is observed only at certain sections in the graph. The inflection points changes the trajectory of the exponential pattern. The distinctive characteristics that led to the outliers require an understanding of the factors that characterized the rapid growth phase.

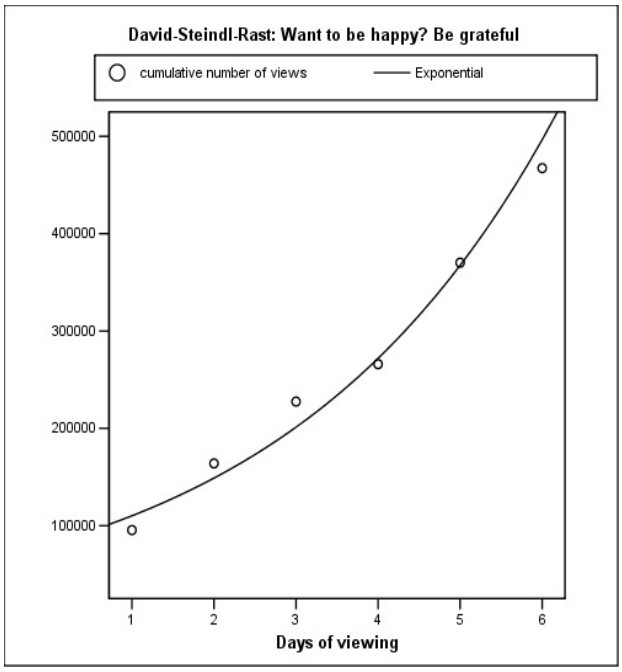

Fig. 14. Exponential curve fit for TED talk of David-Steindl-Rast

TABLE. II. CURVE FIT MODEL FOR TED TALK VIDEOS

Curve fit model		Exponential		S model		Linear		Logarithmic	
TED talk	**Talk ID**	**R^2**	**MSE**	**R^2**	**MSE**	**R^2**	**MSE**	**R^2**	**MSE**
Sandra Aamodt: Why dieting doesn't usually work	1576	0.789	0.1319	0.992	0.0048	0.959	11.43	0.988	3.31
Maysoon Zayid: I got 99 problems... palsy is just one	1573	0.791	0.1444	0.999	0.0005	0.945	21.11	0.996	1.19
Diana Nyad: Never, ever give up - *Inflection point 1*	1571 *Inflection point 1*	0.884	0.0954	0.952	0.0393	0.937	8.97	0.840	22.85
Diana Nyad: Never, ever give up - *Inflection point 2*	1571 *Inflection point 2*	0.945	0.0063	0.912	0.0102	0.980	2.46	0.974	3.21
Paul Piff: Does money make you mean?	1570	0.784	0.1788	0.998	0.0012	0.941	8.03	0.993	1.01
Andrew Solomon: Depression, the secret we share – *Inflection point 1*	1568 *Inflection point 1*	0.693	0.2076	0.965	0.0233	0.889	7.82	0.955	3.15
Andrew Solomon: Depression, the secret we share – *Inflection point 2*	1568 *Inflection point 2*	0.879	0.0047	0.723	0.0109	0.891	27.15	0.855	36.12
David-Steindl-Rast: Want to be happy? Be grateful	1555	0.969	0.0122	0.886	0.0464	0.979	4.73	0.876	28.63

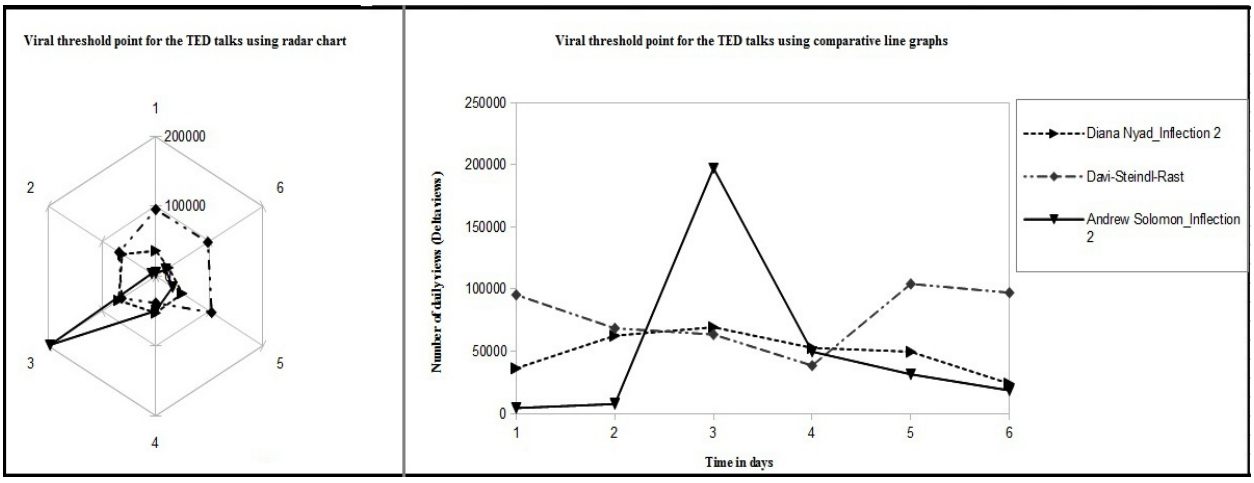

Fig. 15. Viral threshold point for TED talks

2. d) Determining viral threshold point for the identified viral phenomenon trajectories: The exponential growth phase (1) is our with a focus on the growth phase of our data set. The three talks with 'talk ID 1571', 'talk ID 1568' and 'talk ID 1555', that follow the exponential growth phase are further analysed to determine the viral threshold point. A radar chart and a comparative accepted and empirically tested model that determines the trajectory of viral phenomenon. As described in our definition of viral phenomenon, the element of speed (time rate) is a distinctive factor that defines virality i.e., the phenomenon of viral. The viral phenomenon is further differentiated based on viral threshold point i.e., rate of change. A further analysis was performed to identify the viral threshold point. The TED talk video that reached the viral threshold at a faster rate was based on a comparative model analysis with other TED talks in the group. This rate of change i.e., the daily increase in the number of views for the talks is analysed line graph (represented in Fig. 15) helps in depicting the viral threshold point where the daily number of views has the fastest rate of change. The TED talk of 'Andrew Solomon: Depression, the secret we share' with 'talk ID 1568' garners a maximum viewership of 197301, an increase in 2505% rate of change, on day 35 of the posting of the video (as shown in Table. I.).

V. VIRAL PHENOMENON TRAJECTORY

The following inferences on viral phenomenon are drawn based on empirical findings:

Inference 1: A viral phenomenon follows the exponential growth pattern and an inflection point changes the trajectory of the exponential pattern, thereby changing the viral nature.

Inference 2: A viral phenomenon can get triggered at any point during the lifecycle of the product and the viral growth characteristic does not necessarily sustain throughout the lifecycle of the product.

A classification of viral trajectories is offered which identifies the different scenarios of viral penetration based on periodic growth trend. The viral scenarios are represented graphically and are mentioned below:

- Scenario 1: Spike-Plateau (S-P) viral model
- Scenario 2: Spike-Decay (S-D) viral model
- Scenario 3: Plateau-Spike-Plateau (P-S-P) viral model
- Scenario 4: Plateau-Spike-Decay (P-S-D) viral model

Insights from the TED talks sample show that it follows Spike-Plateau (S-P) viral model and Plateau-Spike-Plateau (P-S-P) viral model. The TED talk videos that follow the viral phenomenon trajectory namely, 'talk ID 1571' and 'talk ID 1555' follows the Spike-Plateau (S-P) viral model (represented in Fig. 16 (a)). The Spike-Plateau (S-P) viral model exhibits the viral growth phase at the inception, i.e., during the launch phase of the talk. The inflection point changes the trajectory of the viral growth; thereafter the curve follows a downward trend and later leads to a plateau state. The growth spike for the TED talks is observed on the day of launch or within the first few days of posting of the video. It follows a decline trend when the threshold is attained with the saturation of internet viewers in the interest network group. This follows the phase of plateau with a constant number of daily views, possibly due to new viewers or re-visit of earlier viewers which can be attributed to the heterophilous ties in the network. The TED talk video with the 'talk ID 1568' and consisting of the inflection point 2 follows the Plateau-Spike-Plateau (P-S-P) viral model (represented in Fig. 16 (c)). The first growth spike is observed in the initial posting days of the video as represented in Fig. 10, thereafter it follows a long tail. The second inflection point is observed on day 35 after the video posting (represented in Fig. 10 and as shown in Table. I.). This reaffirms the inference 2 that a viral phenomenon can get triggered at any point in time during the lifecycle.

As observed from our data set, the TED talk videos exhibit long tail phenomenon. The Spike-Decay (S-D) viral model is similar to the S-P viral model in terms of the viral growth phase. The inflection point changes the trajectory of the viral growth leading to a downward trend. This is a case of viral phenomenon where the lifespan of the product is possibly short-lived. The Plateau-Spike-Decay (P-S-D) viral models exhibit viral growth phase at a later stage during the lifecycle of the product and thereafter follows a decline trend. Therefore, the proposed Spike-Decay (S-D) viral model (represented in Fig. 16(b)) and Plateau-Spike-Decay (P-S-D) (represented in Fig. 16(d)) viral model are not exhibited for our data set.

The viral model is graphically represented with the variable of time on X-axis and output defined on Y-axis. The output is a measurement which could be revenue, unit sales, market share, and views, as in the case of TED talks. The scenarios mentioned have certain dimensions encapsulated in the models which lead them to being categorized as viral phenomenon.

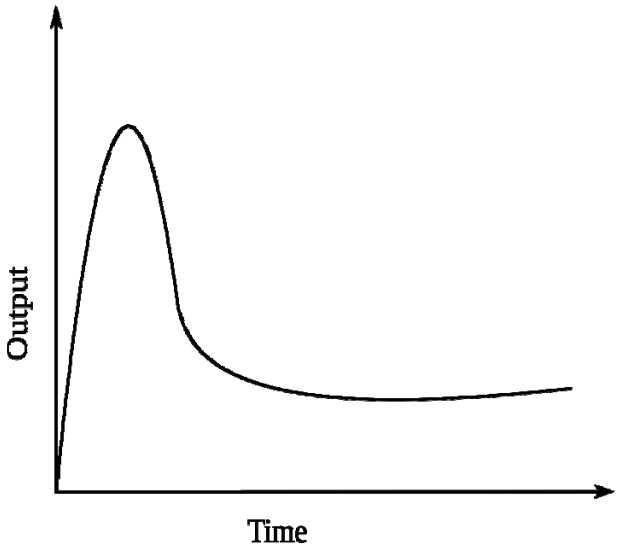

Fig. 16(a) Spike-Plateau (S-P) viral model

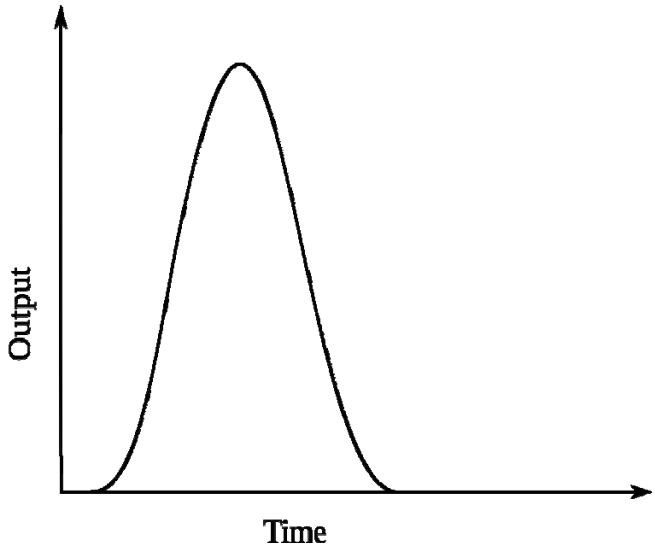

Fig. 16(b) Spike-Decay (S-D) viral model

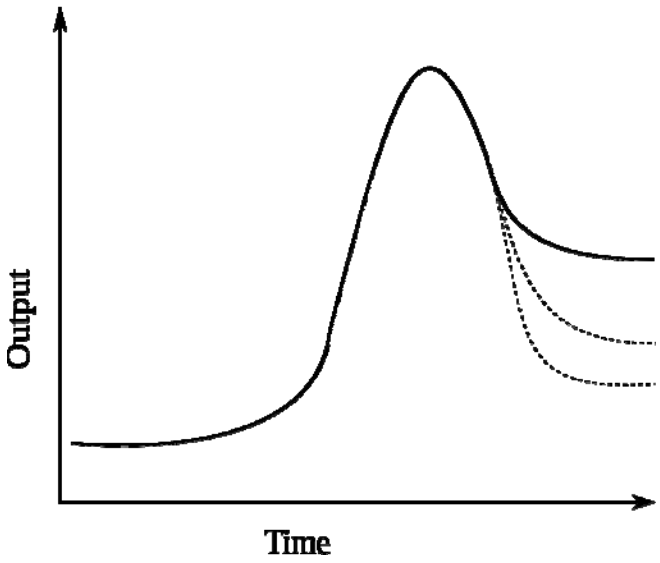

Fig. 16(c). Plateau-Spike-Plateau (P-S-P) viral model

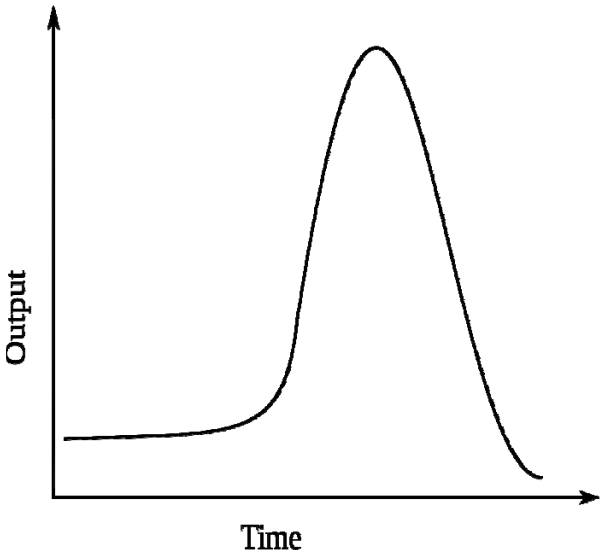

Fig. 16(d). Plateau-Spike-Decay (P-S-D) viral model

VI. CONCLUSION

The purpose of this study was to identify if a product or information exhibits a characteristic growth pattern to categorize and distinguish it as a viral from a non-viral phenomenon. We used TED talk videos to empirically test our study. We find that the viral phenomenon exhibits the nature of exponential growth. A curve fitting methodology was adopted to identify the viral phenomenon trajectory with higher R2 (R squared) value while maintaining a lower MSE (mean squared error) value. The three talks namely, 'Diana Nyad: Never, ever give up' with 'talk ID 1571', 'Andrew Solomon: Depression, the secret we share' with 'talk ID 1568' and 'David-Steindl-Rast: Want to be happy? Be grateful' with 'talk ID 1555', followed the exponential growth phase and thus categorized as following the viral phenomenon trajectory. A further analysis was performed to identify the viral threshold point. The TED talk 'Andrew Solomon: Depression, the secret we share' with 'talk ID 1568' reached the viral threshold at a faster rate based on a comparative model analysis with other TED talks in our data set. The TED talk videos showed an initial growth spike on the day or within first few days of the video posting on the website, thereafter, it followed a decline trend before reaching a state of plateau. Insights from TED talk study reveals that viral growth does not necessarily sustain throughout the lifecycle of the product or information being studied. The findings revealed that the viral growth spike can get triggered at any point during the lifecycle of the product or information after market penetration. It could be triggered during the initial launch phase of the product or during the later stages of the product lifecycle. The inflection points change the trajectory of the viral growth.

With future work we shall explore to understand the insights derived from viral phenomenon of products and information. We intend to provide any advisory information to designers of products such that they can incorporate these insights into their product, service or content innovation at the design conceptualization stage of new product development.

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