1. Preface

1.1. Present Scenario:

Digital World has Social Media Pages/Profiles/Channels representing your business where people engage with you in different ways. It is very important to measure the performance (engagement) of your business in order to:

- compare it with your past performance.
- compare the performance of your different Social Media Pages.
- compare it with the performances of your competitors.

Based on this measurement, you plan your further movement. But it is not as easy as it seems to be to have this measurement.

What we face in Digital World are a number of problems of which few are:

- Plenty of Basic Parameters that Social Media Platforms offer e.g. Views, Likes, Shares, Comments, Followers, etc. *Which one is to consider?*
- Plenty of Composite Parameters that Social Media Experts have made out of Basic ones e.g. Engagement Rate, Audience Growth Rate, Applause rate, etc. *Which one is to consider?*
- Existing Parameters are scalar in nature which means they represent the magnitude (Quantity) only and not the direction (Quality).
    - e.g. Engagement Rate is composed of Total Engagement (not Net Engagement) which doesn't show the sentiment or direction of engagement i.e. whether the Engagement is Positive or Negative (shows Only Quantity not Quality). *What if the engagement is high but is negative?*
- In order to check the sentiment or direction of engagement, you again need to go for another parameter like Net Engagement, Sentiment Analysis, etc.
- Unavailability of a Universal parameter which is capable of representing the performance of your Social Media Pages/Channels (your Digital Health) across all the Platforms.

1.2. Our Mission:

a) Develop One parameter for all platforms: A Universal parameter which is independent of Platforms. Whether you have one platform or multiple platforms, there must be only one Universal parameter to represent the performances of all your platforms taken together i.e. your Digital Health.

b) Develop a Vector parameter: This Universal parameter must indicate the direction of engagement as well along with the magnitude. It must be smart enough to show both the Quantity & Quality of engagement.

With these missions in mind and to solve the current problems, we are introducing the DHS. Let's take a tour.

2. What is DHS?- The Introduction

DHS is an abbreviation for Digital Health Score. It has been created to help Brands (Companies or Individuals) measure the Overall Health of their Pages/Channels across all Social Media Platforms taken together (i.e. your Digital Health).

It can be calculated/measured either for a single Social Media Platform (say Facebook etc.) individually or for multiple Social Media Platforms (say Facebook, Twitter, Instagram, Youtube, etc.) combined together.

It gives a score from 0 to 100 to your Social Media Page(s)/Channel(s) which indicates its Overall Health i.e. how healthy (well) the performance of your page(s)/channel(s) in the Digital World is.

With the slabs defined for DHS, you can:

- Check which slab your DHS falls in and the corresponding Health status of your Page(s)/Channel(s).
- Look for the area of improvement based on the Health status.

2.1. Formula:

Although there are numerous parameters spread in Digital World, we are considering the very Basic parameters, which further contribute to make Composite (bigger) parameters, to design our DHS formula.

$$\boldsymbol{DHS} = \frac{\boldsymbol{e^{ES}}}{\boldsymbol{1 + e^{ES}}} \times \boldsymbol{100}$$

Note: $\frac{\boldsymbol{e^{ES}}}{\boldsymbol{1 + e^{ES}}}$ *is a Sigmoid Function*

Where,

ES = Engagement Score

$$\mathbf{ES} = \frac{\text{Views} + \text{Positive Comments} + \text{Neutral Comments} - \text{Negative Comments} + \text{Likes (Post)} - \text{Unlikes (Dislikes)}^{*} + \text{Shares} + \text{Page Likes}}{\text{Impression (Reach)}^{**} + \text{Page Followers}^{***}} \times \frac{1}{\text{Posts}}$$

** Some platforms have 'Unlikes' whereas some have 'Dislikes'.*

*** For the Platforms having both Impression & Reach, we are taking into account only the maximum of two.*

**** For some Platforms (like YouTube), there are 'Subscribers' instead of 'Page Followers'.*

2.2. Formula Breakup:

Simply put, $\mathbf{ES} = \frac{\mathbf{Net\ Engagement}}{\mathbf{Total\ Awareness}} \times \frac{\mathbf{1}}{\mathbf{Posts}}$

This formula is composed of 11 Basic & 4 Composite Parameters:

Basic: Views, Positive Comments, Neutral Comments, Negative comments, Likes (Post), Unlikes (or Dislikes), Shares, Page Likes, Impression (Reach), Page Followers, Posts (Count of Posts)

Composite: Net Engagement, Total Awareness, Engagement Awareness Ratio (EAR), Engagement Score (ES)

1) **Net Engagement** = Positive Parameters - Negative Parameters

   = Views + Positive Comments + Neutral Comments - Negative comments + Likes (Post) - Unlikes + Shares + Page Likes

NOTE: Net Engagement is the parameter that is going to make the DHS a vector parameter.

2) **EAR: Engagement Awareness Ratio**

- Net Engagement divided by Total Awareness gives the idea about how much engagement (not same as the number of people*) is received with respect to how many people are aware of your brand on Social Media Platform(s).
- **Total Awareness** = Impression (Reach) + Page Followers
- $\mathbf{EAR} = \frac{\mathbf{Net\ Engagement}}{\mathbf{Total\ Awareness}}$

$$\text{EAR} = \frac{\text{Views} + \text{Positive Comments} + \text{Neutral Comments} - \text{Negative Comments} + \text{Likes (Post)} - \text{Unlikes} + \text{Shares} + \text{Page Likes}}{\text{Impression (Reach)} + \text{Page Followers}}$$

** One user may bring multiple engagements e.g. one user may bring one or more comments along with Post Like & Page Like resulting in multiple engagements from a single user.*

3) **ES: Engagement Score**

- It represents EAR per Post. EAR divided by number of Posts averages the Net Engagement to Total Awareness and gives an idea of 'EAR w.r.t. individual post'.
- $\mathbf{ES} = \frac{\mathbf{EAR}}{\mathbf{Posts}} = \frac{\mathbf{Net\ Engagement}}{\mathbf{Total\ Awareness}} \times \frac{\mathbf{1}}{\mathbf{Posts}}$

$$= \frac{\text{Views} + \text{Positive Comments} + \text{Neutral Comments} - \text{Negative Comments} + \text{Likes (Post)} - \text{Unlikes} + \text{Shares} + \text{Page Likes}}{\text{Impression (Reach)} + \text{Page Followers}} \times \frac{1}{\text{Posts}}$$

*NOTE: You can directly calculate the **ES (Engagement Score)** with the help of all Basic Parameters and then calculate the **DHS** with this **ES**. As illustrated in section 2.5 'Example Calculation of DHS'.*

2.3. Parameters used in the Formula:

2.3.1. Numerator:

- Consists of Engagement parameters Under Observation*.
- Parameters showing the various ways through which users interact with a Social Media Page/Channel.
- An indicator of **Net Engagement**.
    a. Net Engagement = Positive Engagement - Negative Engagement
    b. It is the sentiment or direction or quality of engagement and is the indicator of **Overall Health of Engagement** i.e. whether the sentiment of the overall Engagement of a brand is **Positive or Negative (or may be Zero)**.

Table 2.1

Net Engagement	Inference
Positive	Positive Engagement > Negative Engagement
Negative	Positive Engagement < Negative Engagement
Zero	Positive Engagement = Negative Engagement

- **Positive parameters:** Views, Positive Comments, Neutral Comments, Likes (Post), Shares, Page Likes
    a. Views:
        - Sum of total number of views on all the videos Under Observation*.
        - Please note that this includes the number of Views on video posts only and not the Views on photos (Platforms like Facebook show Photo Views as well).
    b. Positive Comments:
        - Sum of total number of Comments with Positive Sentiments on all the posts Under Observation*.
        - e.g. Appreciation, Wishes, etc.
    c. Neutral Comments:
        - Sum of total number of Comments with Neutral Sentiments on all the posts Under Observation*.

- e.g. Enquiry, Feedback, Suggestion, etc.
- Despite having no sign (Positive or Negative) we are **adding them while calculating ES because they do not deteriorate the brand's health** rather they indicate how interested the customers are in your products/services.

d. Likes (Post Likes):

- Sum of total number of Likes on all the posts Under Observation*.

e. Shares:

- Sum of total number of Shares on all the posts Under Observation*.

f. Page Likes:

- Count of total number of Likes on the Social Media Page of your brand.
- This parameter may be available for some platforms like Facebook and may not be available for other platforms like YouTube.
- You can simply put Zero for the platforms where this parameter is unavailable.
- example:

Table 2.2

Platform	Page Likes
Facebook	4500
YouTube	N.A.
Twitter	N.A.

Page Likes = 4500 + 0 + 0 = 4500

- **Negative parameters:** Negative comments, Unlikes (or Dislikes).

a. Negative Comments:

- Sum of total number of Comments with Negative Sentiments on all the posts Under Observation*.
- e.g. Complaint.

b. Unlikes (or Dislikes):

- Sum of total number of Unlikes (or Dislikes) on all the posts Under Observation*.

2.3.2. Denominator:

- Consists of Parameters that regulates/controls the Engagement OR the Deciding Factor of Engagements for the posts Under Observation*.
- Larger these parameters are, larger will be the Engagement parameters.
- It has two parts:

a. Total Awareness:
    - Parameters showing the magnitude of **Awareness of your Social Media Page(s)/Channel(s)**.
    - An indicator of **Total Awareness** i.e. how many people are aware of your products/services.
    - Impression (Reach), Followers (or Subscribers for some Platforms like YouTube).
    - Although Impression & Reach are separate entities, to avoid confusion and complication, we are considering only one at a time because some platforms (like Facebook, etc) have both of these parameters while others are having either of them.
    - So, **if both Impression and Reach are available:** we are considering the parameter with greater (maximum of two) value.

b. Posts:
    - Count of total number of Posts Under Observation*.

2.4. Under Observation*:

- You can choose the Platform(s) & The Post(s) that you want to calculate the DHS for.
- And this very collection, the basket of Platform(s) & The Post(s) is what we are referring to as Under Observation.
- Example:
    - Independent of Platforms:
        - You can put all Posts from a single Platform (e.g. Facebook) Under Observation.
        - Or, You can put all Posts from multiple Platforms (e.g. Facebook, Twitter, Instagram, Youtube, etc.) Under Observation.
    - Independent of Posts:
        - You can select specific Posts that you want to Observe from a single Platform or multiple Platforms.
        - e.g. You may want to calculate the DHS only for the Posts (for one or multiple Platforms) that you have posted in January month.
        - Or, you may want to calculate the DHS only for the Posts (for one or multiple Platforms) that you have posted on Mother's Day for the last 5 (or any other number of) years in order to compare it with the DHS of your Posts on Christmas for the same duration.
- So, it's solely up to you to make the selection, the basket, of Platform(s) and Post(s) that you want to Observe.
- You get (DHS) what you feed (Combination of Platforms & Posts).

2.5. Example Calculation of DHS:

We are considering all the Posts (from First to Last) on all the Platforms Under Observation.

Table 2.3

	Facebook	Instagram	YouTube	Total
Views	399	1498	3464	5361
Positive Comments	58	49	59	166
Neutral Comments	7	1	19	27
Negative Comments	4	1	20	25
Likes (Posts)	246	1144	568	1958
Unlikes (or Dislikes)	0	0	43	43
Shares	0	0	7	7
Page Likes	8561	N.A.	N.A.	8561
Reach (or Impression)	Reach = 8226 (Impression = 8787)	Reach = 7457 (Impression = 8809)	Impression = 9753	8787 + 8809 + 9753 = 27349
Page Followers	8757	3229	Subscribers = 243	12229
Posts	21	11	10	42
ES	0.02593814813881821	0.02032201060278814	0.0405562224889956	0.009632576058368165
DHS	50.648417349952545	50.508032781067768	51.013766611816905	50.24081253944893

1) **Overall DHS:**

Positive Parameters = Views + Positive Comments + Neutral Comments + Likes (Post) + Shares + Page Likes = 5361 + 166 + 27 + 1958 + 7 + 8561 = **16080**

Negative Parameters = Negative comments + Unlikes = 25 + 43 = **68**

Net Engagement = Positive Parameters - Negative Parameters
= Views + Positive Comments + Neutral Comments - Negative comments + Likes (Post) - Unlikes + Shares + Page Likes = 16080 - 68 = **16012**
EAR = Net Engagement / Total Awareness = 16012 / (27349+12229) = 0.4045681944514629

Engagement Score = EAR/Posts = 0.4045681944514629 / 42 = 0.009632576058368165

$$\mathbf{DHS} = \frac{\mathbf{e^{ES}}}{\mathbf{1} + \mathbf{e^{ES}}} \times \mathbf{100} = \mathbf{50.24081253944893}$$

2) **Facebook DHS:**

$$\mathbf{ES} = \frac{399 + 58 + 7 - 4 + 246 - 0 + 0 + 8561}{8787 + 8226} \times \frac{1}{21} = 0.02593814813881821$$

$$\mathbf{DHS} = \frac{\mathbf{e^{ES}}}{\mathbf{1} + \mathbf{e^{ES}}} \times \mathbf{100} = \mathbf{50.648417349952545}$$

3) **DHS comparison as per Table 1.3:**

DHS (Overall) < DHS (Instagram) < DHS (Facebook) < DHS (Youtube)

You can calculate the DHS for specific posts in the same manner.

2.6. Summary of DHS:

We are calculating the Net Engagement w.r.t. Total Awareness per Post which simply represents the ratio of how much engagement is actually received to how much engagement could have been received.

Then, we are converting this resulting figure (Engagement Score) to a number in the restricted range of 0 to 100 to make it more readable and comparable.

NOTE: Net Engagement is not the number of people who are engaging. One user may bring multiple engagements e.g. one user may bring one or more comments along with Post Like & Page Like resulting in multiple engagements from a single user.

NOTE: We are using Sigmoid Function to convert the number from a range of -infinity to +infinity to a range of 0 to 1.

3. Why DHS?- Importance

When it comes to comparing the performance of your Social Media Page with your competitors' pages or the performance of your own pages on different Social Media Platforms or the performance of your specific posts on same Platform, what we face is a bunch of parameters (Basic & Composite) which brings confusion, chaos and complication.

3.1. Existing Problem:

- We have a number of Basic Parameters: View, Comment, Post Like, Unlike/Dislike, Page Like, Share, Follower, Reach, Impression.
- Problem with Basic Parameters:

    - It's cumbersome to compare the performance of your Social Media Page w.r.t. individual parameters.
    - Different Platforms have different Basic Parameters e.g. Facebook has both Reach and Impression while Twitter has only Impression.
- So, experts have made several Composite Parameters: Engagement Ratio, Applause Rate, etc.
    - Problem with Composite Parameters: At present, there is no hard & fast rule to make such parameters and so there is no uniformity with these parameters i.e. with varying Experts (companies or agencies designing the Composite Parameters), same Composite Parameters may vary in terms of their Basic Parameters which they are composed of.
    - Also, there is a large number of such parameters (which is even increasing with days passing by) spread up in the Digital World which brings forth a lot of confusion and complication e.g. which Composite Parameter is more important than the other, which one is best suited to represent the performance of your Page, etc.
    - Existing parameters like Engagement Rate doesn't show whether the Engagement is Positive or Negative (shows Only Quantity not Quality). This is because it is composed of Total Engagement which is the sum of total comments, likes and shares ignoring the sentiment of comments (whether they are Positive, Negative or Neutral) and Unlikes. e.g. Suppose Brand A has an Engagement Ratio of 2.4% and Brand B has 3.8%. As per existing structure, one can simply conclude that Brand B is performing better than Brand A based on Quantity of Engagement but we are completely ignoring the Quality of Engagement (if it is Positive or Negative) which is a misinterpreted analysis.
- Absence of a Universal Parameter which is equally fit for all the platforms.

3.2. Solution we offer:

We have picked all (11 in total) the Basic Parameters that a Social Media Page can have irregardless of the Platform.

You can put Zero for the parameter which a Platform doesn't have. Already, described in section 2.5 (Example Calculation of DHS) Table 2.3.

We have also made a few (4 in total) Composite Parameters **Net Engagement, Total Awareness, EAR (Engagement Awareness Ratio), ES (Engagement Score)** out of the 11 Basic Parameters.

However, it is not mandatory to consider (or calculate) all these Composite Parameters individually.

You can directly calculate the **ES (Engagement Score)** with the help of all Basic Parameters and then calculate the **DHS** with this **ES**. As illustrated in section 2.5 (Example Calculation of DHS).

Now, you have only one parameter, DHS, to check & compare the performance of your Page with your competitors' Pages. Also, it is a vector showing the direction of engagement as well since it is composed of Net Engagement instead of Total Engagement.

We have solved the problem of chaos, confusion & complication created by multiple parameters scattered the Digital World and have successfully come up with a single parameter, DHS, which is Uniform, Universal and smart enough to represent your performance in the Digital World (your Digital Health) i.e. performance of your Social Media Page in terms of both Quantity & Quality.

Following table illustrates the Problems with Existing parameters and the Solution we offer with the introduction of DHS:

Table 3.1

Feature	Existing Parameters	DHS
Number of parameters	Number of parameters is very large in the existing Digital World.	Only One parameter.
Confusion	Lots of confusion, chaos & complication due to so many parameters i.e which to consider, which not to.	No confusion because of only one parameter.
Uniformity	No uniformity i.e. same parameter may have different meaning as per different experts.	DHS is uniform, it can not vary.
Engagement Quality	Scalar: Parameters like Engagement Rate express only the magnitude (Quantity) of engagement and not the direction (Quality). Because it considers total comments only ignoring the Negative comments over Positive & Neutral ones. Also, it considers Likes only ignoring the Unlikes.	Vector: It has both magnitude & direction which makes it both quantitative & qualitative. Because it is composed of Net Engagement which consists of Positive, Negative & Neutral comments separately. Also, it has both Likes & Unlikes.
	To check the direction (Quality) of engagement, we have to do the Sentiment Analysis separately.	It gives an idea of direction of engagement. DHS below 50 indicates Negative engagement.
Universal nature	No universal parameter for all the platforms i.e. you have to calculate the Engagement Rate separately for different platforms.	It is universal. You can calculate the DHS for all the platforms combined together or separately.
Example	Engagement Rate of brand A is 2.4% & of brand B is 3.8%. It shows B is doing better than A irregardless of the direction (quality) of engagement.	DHS of brand A is 50.98 & of brand B is 49.80. It shows the Net Engagement for brand B is negative since DHS is below 50.

4. Tables

4.1. DHS Table:

This is the main table that you can refer to check the Health Status of Your Social Media Page w.r.t. the DHS that you've come up with and the corresponding Risk Level & Measure.

Table 4.1

<table>
<tr><th>Health Status</th><th>DHS</th><th>Risk Level & Measure</th></tr>
<tr><td>Dying</td><td>0.00 - 25.00</td><td rowspan="3">Unacceptable; There must be some strong reason (like Spam or Fraud) bringing this much negative engagement. Immediately look for the source, take the corrective measure and try not to repeat that in future. It is highly likely that you may not recover from this condition.</td></tr>
<tr><td>Worst</td><td>25.00 - 37.75</td></tr>
<tr><td>Very Bad</td><td>37.75 - 47.50</td></tr>
<tr><td rowspan="2">Bad</td><td>47.50 - 49.75</td><td rowspan="2">Highly Risky;
You must work to make the Net Engagement Positive.</td></tr>
<tr><td>49.75 - 50.00</td></tr>
<tr><td>Unwell</td><td>50</td><td>Risky;
You must work to make the Net Engagement Positive.</td></tr>
<tr><td>Well</td><td>50.00 - 50.25</td><td>Tolerable;
It can fall to Negative side anytime, so, You should work to improve the Net Engagement</td></tr>
<tr><td>Good</td><td>50.25 - 52.50</td><td rowspan="4">No Risk; You are doing good. Keep maintaining the status</td></tr>
<tr><td>Perfectly Fine</td><td>52.50 - 62.25</td></tr>
<tr><td>Super Fit</td><td>62.25 - 75.00</td></tr>
<tr><td>Immortal</td><td>75.00 - 100.00</td></tr>
</table>

4.2. There are other supporting Tables related to DHS too that can be referred to get more information about the relationship of DHS, ES, EAR, Basic Parameters & Composite Parameters with each other.

4.2.1. This table illustrates the relationship of DHS, Basic parameters & Composite Parameters. It shows DHS, the corresponding magnitude & direction of ES & Net Engagement and the corresponding variation of Basic Parameters.

Table 4.2

DHS	Basic Parameters	Composite Parameters: Net Eng, EAR, ES	ES	Inference: Magnitude of Net Engagement
0.00 - 0.67	Sum of Negative parameters is greater than sum of Positive parameters	Negative	Less than -5.00	Net Engagement is above 500% of Total Awareness.
0.67 - 1.80			-5.00 to -4.00	Net Engagement is 400 to 500% of Total Awareness.
1.80 - 12.00			-4.00 to -3.00	Net Engagement is 300 to 400% of Total Awareness.
4.75 - 12.00			-3.00 to -2.00	Net Engagement is 200 to 300% of Total Awareness.
12.00 - 25.00			-2.00 to -1.09	Net Engagement is 110 to 200% of Total Awareness.
25.00 - 37.75			-1.09 to -0.50	Net Engagement is 50 to 110% of Total Awareness.
37.75 - 47.50			-0.50 to -0.10	Net Engagement is 10 to 50% of Total Awareness.
47.50 - 49.75			-0.10 to -0.01	Net Engagement is 1 to 10% of Total Awareness.
49.75 - 50.00			-0.01 to 0.00	Net Engagement is 0 to 1% of Total Awareness.
50	Sum of Negative parameters is equal to the Sum of Positive parameters	0	0	Sum of Negative parameters is equal to Sum of Positive parameters. Net Eng = EAR = ES = 0
50.00 - 50.25	Sum of Positive parameters is greater than the sum of Negative parameters	Positive	0.00 - 0.01	Net Engagement is 0 to 1% of Total Awareness.
50.25 - 52.50			0.01 - 0.10	Net Engagement is 1 to 10% of Total Awareness.
52.50 - 62.25			0.10 - 0.50	Net Engagement is 10 to 50% of Total Awareness.
62.25 - 75.00			0.50 - 1.099	Net Engagement is 50 to 110% of Total Awareness.
75.00 - 90.00			1.099 - 2.20	Net Engagement is 110 to 220% of Total Awareness.
90.00 - 95.25			2.20 - 3.00	Net Engagement is 220 to 300% of Total Awareness.

95.25 - 98.20			3.00 - 4.00	Net Engagement is 300 to 400% of Total Awareness.
98.20 - 99.33			4.00 - 5.00	Net Engagement is 400 to 500% of Total Awareness.
99.33 - 100.00			More than 5.00	Net Engagement is above 500% of Total Awareness.

4.2.2. Important Nodes (Points) of DHS:

This table illustrates the relationship of DHS, ES & EAR. It shows important nodes (points) of ES with the respective DHS & EAR.

Table 4.3

DHS	ES	EAR = Net Eng w.r.t. Awareness
0.6692850924	-5	Net Eng = -5 * Awareness
1.798620996	-4	Net Eng = -4 * Awareness
4.742587318	-3	Net Eng = -3 * Awareness
11.9202922	-2	Net Eng = -2 * Awareness
26.89414214	-1	Net Eng = -Awareness
37.75406688	-0.5	Net Eng = -50% of Awareness
47.50208125	-0.1	Net Eng = -10% of Awareness
48.75026035	-0.05	Net Eng = -5% of Awareness
49.75000208	-0.01	Net Eng = -1% of Awareness
50.00	0	Net Eng = 0
50.24999792	0.01	Net Eng = 1% of Awareness
0.5124973965	0.05	Net Eng = 5% of Awareness
52.497918747894	0.1	Net Eng = 10% of Awareness
62.24593312	0.5	Net Eng = 50% of Awareness
73.10585786	1	Net Eng = Awareness
88.0797078	2	Net Eng = 2 * Awareness
95.25741268	3	Net Eng = 3 * Awareness
98.201379	4	Net Eng = 4 * Awareness
99.33071491	5	Net Eng = 5 * Awareness

Future Scope of Improvement:

A Share may also be Positive or Negative which we have ignored as of now. What we mean is the reason of Share i.e. a user may be sharing some post to highlight your negative aspect which must go to Negative Parameter in Net Engagement as it is deteriorating your Digital Health (i.e. Social Media Page's health). We will look to include it as well in future.