

Unlock Different V's of Big Data for Analytics

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Available online at: www.ijcseonline.org

Abstract— This paper aims to review the purpose of the Big Data characteristics, to identify Big Data solutions in different perspective. In 2001, the first three 'V' (Volume, Velocity, and Variety) dimensions of Big Data are addressed. Later, V's like Variability, Veracity, Virality, Visualization and Value were compiled from several sources including IBM, Data Science Central, National Institute of Standards and Technology (NIST) etc.,. Recently, characteristics of Big Data increased to understand and analyze the big data efficiently and effectively. The big data and big data policy can be better revealed by adding more V's. Addition of more V's was providential, in the sense that big data first act in response were meet these additional challenges with this massive data. The new V's are added to the list will provide valuable and most excellent observation over the data. Therefore, this study tries to summarize the available characteristics in the literature to get the better picture about Big Data further. From this, it has been observed that there are more than 54 V's dimensions (characteristics) like Venue, Vocabulary, Vendible, Validity, Volatility, Verbosity, Vagueness, Vanity, Voracity and so on. These characteristics were emerged to suit different applications and domains. This review results in finding the impacts of V's on Big data analytics.

Keywords— Big Data, Analytics, V's, Volume, Variety, Velocity, Business analytics

I. INTRODUCTION

The Large-scale Industries, Organizations are indeed facing challenges to maintain their data in conventional systems storages due to their enormous volume. The data warehousing concept has been emerged to store knowledge of older data in past days. Nowadays, the digitalization leads to vast data generation in every sector. The data generation per second will be in the range of petabytes and more, results in data deluge situation. Thus the data warehousing concept is quite meaningless for this kind of voluminous data which is coined as Big Data. Similarly, these data can be of more variety which represents the different data formats. As well as these data are generated at different velocity from the different sources. Therefore, the characterization of the Big data is changed based on the current trend in terms of volume, variety, velocity and so on. The digital trend of characterizing the Big data in V-forms like Volume, Variety, Velocity and so on that are the different dimensional views of data. Similarly the different researchers at different period have defined different V-characteristics based on the nature of Big data and on their requirements.

Analyzing Big Data is a hectic process. The data analysts are suffering to handle this Big data situation. Even though the sampling techniques are used for analyzing big data, it

provides biased results. Therefore analyzing Big Data became a challenging task to the researchers. Many techniques, frameworks are emerged, still the disputes are prevailed. So the data are characterized to better fit the techniques and frameworks as well as the conventional databases. The characterization of big data has been evolved in the recent times. These multiple dimensional view of big data makes the researchers to feel not-a-big data. Thus selection of such dimensions is entirely domain and application dependant. This paper mainly reviews these different V-characteristics of Big Data at different stages on various domains. This paper first summarizes various definition of Big data; followed by evolution of big data till now is tabulated, then the various applications of big data are discussed, finally based on this review, new applications of all the V-characteristics are also suggested.

II. BIG DATA

Big data incorporates all the varieties of data, including structured data and unstructured data from e-mails, social media, text streams, and so on. This kind of data management requires companies to leverage both their structured and unstructured data. Similarly many researchers

suggested many different views on Big data that are discussed as follows.

A. Definitions

- Jason Williamson et al [1] mentioned that the definition of big data depends on whether the data can be ingested, processed, and examined in a time that meets a particular business's requirements. For one company or system it may be 50TB; for another it may be 10PB.
- Big Data is not just about lots of data, it is actually a concept providing an opportunity to find new insight into the existing data as well as guidelines to capture and analyze the future data. It makes any business more agile and robust so it can adapt and overcome business challenges [2] [3].
- Margaret Rouse [4] et al says, "Big data is an evolving term that describes any voluminous amount of structured, semi-structured and unstructured data that has the potential to be mined for information".
- Gartner says [5] [6] "Big data is high-volume, high-velocity and/or high-variety information assets that demand cost-effective, innovative forms of information processing that enable enhanced insight, decision making, and process automation".
- The term "big data" is relatively new, the act of gathering and storing large amounts of information for eventual analysis is ages old. The concept gained momentum in the early 2000s when industry analyst Doug Laney [6] articulated the now-mainstream definition of big data as the three Vs Volume, Variety, and Velocity.
- Big data refers to a process that is used when traditional data mining and handling techniques cannot uncover the insights and meaning of the underlying data. Data that is unstructured or time sensitive or simply very large cannot be processed by relational database engines. This type of data requires a different processing approach called big data, which uses massive parallelism on readily-available hardware [7] [8].
- Big data enables organizations to store, manage, and manipulate vast amounts of disparate data at the right speed and at the right time [9]. To gain the right insights, big data is typically broken down by three characteristics:
 - **Volume:** How much data
 - **Velocity:** How fast data is processed
 - **Variety:** The various types of data
- "Big data" is high-volume, -velocity and -variety information assets that demand cost-effective, innovative forms of information processing for enhanced insight and decision making. There are differing opinions with the number of characteristics – "V dimensions" are needed to identify a project as 'Big Data'. The original three V's – Volume, Velocity, and Variety – appeared in 2001 when Gartner analyst Doug

Laney [6] used it to help identify key dimensions of big data [21].

- Gartner's [5] [6] big data definition is not much longer than a tweet: "Big data" is high-volume, -velocity and -variety information assets that demand cost-effective, innovative forms of information processing for enhanced insight and decision making. Most of the researchers suggested the basic 3 V's which is simple and convenient to follow. This is for simple data which may be all structured or all unstructured. The big data can never be the simple data, it will be more complex in terms of their type and characteristics. Based on the domain, requirements the characteristic of the big data are devised. Thus the works done in hours can be done in seconds. These classifications of big data characteristics will refine its applications which is data driving aid for Business sectors [10], financial sectors, Corporate analytics and so on.

III. REVIEW ON V-CHARACTERISTICS OF BIG DATA

The data explosion is upon us, with increasing amount of data production each day [11], there is no sign of stopping, or even slowing down. In 2009, research firm IDC noted a 62 percent increase in worldwide data over the previous year, and predicted that digital information, which in 2009 had reached 0.8 zettabytes (one zettabyte equals a trillion gigabytes), could reach as much as 44 zettabytes by 2020.

The various V-characteristics of Big data existing in the literature, 2001 onwards are discussed in this section as follows.

- **Volume** represents the quantity of data in terms of petabytes, yottabytes upto Geopbytes depends on the data generation per second. It will be differ for different organization. The higher end conventional storage devices used by large scale organization are not enough to database the big data as the days goes on [5] [6].
- **Velocity** represents the frequency of incoming data that needs to be processed. Some applications receives data shelf life is too short, even some data are killed by the competitors. The frequency of data streaming matters many application. The analysis of such characteristic showcases the required knowledge from big data very well [12].
- **Variety** that addresses the inherent trustworthiness of data. The uncertainty about the consistency or completeness of data and other ambiguities can become major obstacles. As a result, basic principles as data quality, data cleansing, master data management, and data governance remain critical disciplines when working with Big Data. [13] [14]
- **Veracity** This refers to the accuracy, reliability. Veracity has an impact on the confidence data [15] [5].

- **Value** the all-important V, characterizing the business value, ROI, and potential of big data to transform your organization from top to bottom. It is all well and good having access to big data but unless we can turn it into value it is useless. It is so easy to fall into the buzz trap and embark on big data initiatives without a clear understanding of costs and benefits [16].
- **Viability** Biehn, “to carefully select the attributes and factors that are most likely to predict outcomes that matter most to businesses; the secret is uncovering the latent, hidden relationships among these variables” [17].
- **Validity** data quality, governance, master data management (MDM) on massive, diverse, distributed, heterogeneous, “unclean” data collections [12] [15] [8].
- **Vagueness** confusion over the meaning of big data. It is about its nature, content availability, tools availability, tools selection, etc [18].
- **Virility** Big Data creates itself, in and of itself. The more Big Data you have, the more Big Data gets created. It’s like a self-fulfilling prophecy in 360 degree, high-definition, poly-faceted and all-encompassing knowing [19] [20] [5].
- **Vendible** The sale ability of Big Data proves its existence. The very existence of client’s for Big Data demonstrates conclusively that it is tangible – at least in market terms, and it’s the market that rules [21] [22].
- **Vanity** data is vain means merely that it is pleased with the effect it produces on other people. Conceited data is satisfied with the effect it produces on itself [21] [22].
- **Voracity** Big Data is big and it has an omnipresent and insatiable self-fulfilling desire. Big Data is potentially so voracious that it may attain the clout, control and the capability to eat itself, alive [21] [22].
- **Variability** means that the meaning is changing (rapidly) dynamic, evolving, spatiotemporal data, time series, seasonal, and any other type of non-static behaviour in your data sources, customers, objects of study, etc [16].
- **Visualization** Making all that vast amount of data comprehensible in a manner that is easy to understand and read [23].
- **Venue** distributed, heterogeneous data from multiple platforms, from different owners’ systems, with different access and formatting requirements, private vs. public cloud [24].
- **Vocabulary** schema, data models, semantics, ontologies, taxonomies, and other content- and context-based metadata that describe the data’s structure, syntax, content, and provenance [23].
- **Volatility** Big data volatility refers to how long is data valid and how long should it be stored. In this world of real time data you need to determine at what point is data no longer relevant to the current analysis [23] [24] [15].
- **Visible** Information silos have always existed within enterprises and have been one of the major roadblocks in the attempt to extract value from data. Relevant information should not only exist, but should also be visible to the right person at the right time. Actionable data needs to be visible transcending the boundaries of functions, departments and even organizations, for value unlocking [25].
- **Visual** We live in an increasingly visual world and the statistics of increase in the number of images and videos shared on the Internet is staggering. According to official statistics, 300 hours of video are uploaded every minute on YouTube. In a business context, appropriate visualization of data and dashboards is critical for the management to be able to extract value from their limited time, resources and even more limited attention span [25].
- **Vitality** or criticality of the data is another concept that is crucial and is embedded in the concept of Value. Information that is more meaningful or critical to the underlying business objective needs to be prioritized. Analysis paralysis needs to be replaced with a more pragmatic approach. Technology allows marketers to create segments of one, but is such extreme segmentation vital or even aligned to the organizational strategy? [25].
- **Vincularity** Derived from Latin, it implies connectivity or linkage. This concept is very relevant in today’s connected world [25].
- **Vulnerability** It is about keeping the data safe and secure, to avoid the vulnerability of data means accessing data for malicious purposes [25].
- **Verification** The data follows the standardization in many aspects to show its trustworthiness [25].
- **Virality** Defined by some users as the rate at which the data spreads; how often it is picked up and repeated by other users or events [18].
- **Valor** In the face of big data, we must gamely tackle the big problems [15].
- **Verbosity** Verbosity means that within the unstructured, the semi-structured, and in structured data, there is a lot of redundancy, often the majority of raw volume. Understanding how to quickly disentangle the meaning you care about from its redundancies is important for efficiency of processing, but even more important for supporting the value and versatility dimensions, the reuse, of the data [25].

Table: 1. Evolution of Big Data V's

Authors \ V's	Volume	Velocity	Variety	Varacity	Value	Viability	Validity	Volatility	Vagueness	Virility	Vendible	Voracity	Vanity	Variability	Visualization	Venue	Vocabulary	Visibility	Visual	Vitality	Vincularity	Vulnerability	Verification	Virality	Valor	Verbosity	Vaticination	Valence	Versality	Viscosity
Doug Laney (2012) [6]	✓	✓	✓																											
Steve Baunach (2012) [11]	✓	✓	✓																											
Doug Laney (2012) [6]	✓	✓	✓																											
Wang R R(2012) [25]										✓																			✓	
Kevin ormandeau (2013) [26]	✓	✓	✓	✓			✓	✓																						
Jason Tee(2013) [27]	✓	✓	✓	✓																										
Neil Biehn(2013) [17]	✓	✓	✓	✓		✓																								
Gartner (2013) [5]	✓	✓	✓																											
Seth Grimes (2013) [21]	✓	✓	✓																											
Eileen mcnulty (2014) [28]	✓	✓	✓	✓	✓									✓	✓															
Dr.Kirk Borne (2014) [29]	✓	✓	✓	✓	✓		✓		✓					✓		✓	✓													
Jason Bowden (2014) [30]	✓	✓	✓	✓	✓																									
Richard J Self (2014) [31]	✓	✓	✓	✓	✓		✓	✓						✓	✓							✓	✓			✓				
Svetlana(2014) [32]	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓							✓						
Guoru Ding (2014) [22]	✓	✓	✓	✓	✓	✓																						✓		
GoodStratT weet (2015) [33]	✓	✓	✓						✓	✓	✓	✓	✓														✓			
Rajiv Maheshwari (2015) [34]	✓	✓	✓	✓	✓		✓	✓						✓					✓	✓	✓	✓								
Soumendra mohanty (2015) [35]	✓	✓	✓	✓																										
Jason Williamson (2015) [1]	✓	✓	✓																											
Margaret Rouse (2016) [4]	✓	✓	✓																											
David Gewirtz (2016) [36]	✓	✓	✓																											
Dr. Darrin(2016) [37]	✓	✓	✓	✓	✓																									
Mark van Rijmenam [38]	✓	✓	✓	✓	✓									✓	✓															
Ashley DeVan(2016) [39]	✓	✓	✓	✓	✓									✓	✓															
George W. Bush	✓	✓	✓	✓	✓		✓							✓																
Ashley DeVan (2016) [39]	✓	✓	✓	✓	✓									✓	✓															
Richard Mallah (2018) [40]	✓	✓	✓	✓	✓														✓							✓		✓	✓	

✓represents existing V's

- **Valence** it represents the interconnectivity among the data. The more valence among data increases the complexity of the data [25]
- **Versality** Versatility of data reflects how useful the data is, in different scenarios, and in applications for different sets of stakeholders, despite invariably having been created for a certain purpose. Understanding its quality, provenance, meaning, and context are a key to this [25].
- **Viscosity** Viscosity is with how much ease or difficulty data can be flowed to other use cases that would

leverage its versatility. Highly viscous data has a lot of internal friction stemming from bespoke, though hopefully internally consistent, representations that, at minimum, require high-touch interpretation, transformation, and integration [25]

The other V's that are emerged and under research are Vane, Vanilla, Vantage, Varifocal, Varmint, Varnish, Vastness, Vault, Veer, Veil, Verdict, Verse, Version Control, Vet, Vexed, Vibrant, Victual, Virtuocity, Vivify, Vogue, Voice, Voodoo, Voyage, Vulpine.

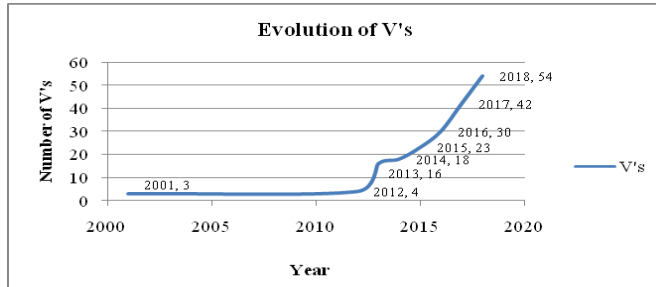


Figure 1. Evolution of V's

The evolution of V's till now are reviewed and listed in the table 1. The different researchers at different period were suggested many V's for various applications. These applications are also reviewed and tabulated in table 2. It depicts that different applications like Business analytics, Financial Analytics, Social Data Analytics, etc. prefer different kinds of V's over this period which are marked using tick symbol in the table 2. The evolution of the BigData V's from 2001 onwards is visualized in the figure 1. The researchers also state that it may rise upto 100 V's in future for efficient Big data analytics.

IV. DISCUSSION ON V-CHARACTERISTICS OF BIG DATA

This review widely shows the necessity of V's of Big data which is mainly depends on the application requirements. It also shows that some V's are used specifically to one or two applications. The application oriented V's are further suggested in this paper. The suggested V's are marked as stars in the table 2.

In Financial sector the basic Characteristics like Volume, Velocity, and variety are used. Besides, the validity of financial data is necessary to perform analytics; the region of interest (Value) the financial sectors focuses is desirable. The existence (volatility) of financial data is significant part to know about the existent trend on the financial sector. The ambiguities (Vagueness) of financial information have to be handled for betterment of financial decision making.

Social media are the main source of data explosion nowadays. Many V-characteristics of big data are applied for social data analytics. In addition to that other characteristics like Volatility, Vendible, Voracity, Vocabulary, Virality, Verbosity can be chosen for betterment of the analysis. In social data the existence of particular trends, concepts, people perceptions can be focused. Most of the social websites are promoting various products among the people, so the social data relevant to the commercial nature can be concentrated. Further, in the social websites people uses their local lingual terms as well as the synonyms and frequency of these terms can be gathered for social data analytics. The virality of the matters or issues among the social networks are the driving triggers of the future trends. Therefore, these V's for social data analytics will be considered to fine tune the analysis. The social media places the vital part in the e-

commerce for mainly promoting their products. It is the major marketplace for the online shopping. The e-commerce analytics like locating the target groups of their products, marketing their products requires different view on big data. For this purpose, the characteristics of big data like the area of marketing(Value), the attribute of interest (viability), the data that are commercial (vendible), the location like urban or rural area of the target audience (venue), the local lingual terms and their synonyms (vocabulary).

The IT sector is also one of the driving force of the business economics. The IT Analytics insight the performance, availability, and capacity of applications and infrastructure investments, etc in the IT sector for decision making. The choice of data to be analyzed (value), market the products (vendible) can be added for efficient IT data analytics. In the wireless technology the utilization of the spectrum over various sector is the major challenge due to social data deluge networks. Thus the acquisition of this radio spectrum requires more data analytics for decision making. The data characteristics like venue of the data generation, the significance of data attributes, the vulnerable data points, vitality of the big data, can be suggested to focus for further analysis and results in optimal networking.

The next application is IoT analytics, the world will be connected with Internet of things in next few years. The IoT sensors are next to Social websites in data generation. Thus the IoT Big Data must handle with more V's for most favourable decision making over IoTs. The sensor data have to be characterized based on the saleability on the data (Vendible) for marketing the IoT products. The ambiguous data (Vagueness) have to be focused and handled for enhanced results of Data analysis. The location is the important parameter of most of the IoT applications (Venue). The significant portions (vitality) of the sensor data are considered which mainly depends on the application requirement.

The Weather Prediction is most desirable field of Big data analytics. The seasons, trends are changing due to the environmental and social changes. Already 10 V-characteristics are applied for weather prediction for handling Weather big data. Besides, the other V-characteristics like viability, virility, visual, verification are suggested for weather data analysis. The relationships between the different attributes, selection of the attributes based on the region are under the viability of the Weather Big data. Similarly, weather data from the standard sources and efficient sources have to be spotlighted under the verification character.

Thus different other V-characteristics for some of the Big Data applications are suggested to optimize the data analytics in these discussed domains and also showcase the big data opportunities for the future researchers in these fields.

Table 2. Review on Applications of V's

V's \ Applications	Volume	Velocity	Variety	Varacity	Value	Viability	Validity	Volatility	Vagueness	Virility	Vendible	Vanity	Voracity	Variability	Visualization	Venue	Vocabulary	Visible	Visual	Vitality	Vincularity	Vulnerability	Verification	Virality	Valor	Verbosity	Vaticination	Valence
Financial Services industry	✓	✓	✓		*		*	*	*				*															
Social Data Analytics	✓	✓	✓	✓	✓			*		✓	*		*	✓	✓		*							*		*		
E-commerce Analytics	✓	✓	✓		*	*					*						*	*										
IT Analytics	✓	✓	✓	✓	*	✓	✓	✓			*															*		
Business Management and Analytics	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Data Science	✓	✓	✓	✓		*	✓	✓	*								*		*				*					
Wireless Networking [22]	✓	✓	✓	✓	✓	✓							*	*		*				*		*						
Internet of Things	✓	✓	✓	✓	✓				*		*		✓	✓		*			*	*								
Weather Prediction	✓	✓	✓	✓	✓	*	✓		✓	*			✓	✓		✓	✓		*				*					

✓ represents existing Vs'
 * represents the suggested Vs'

V. IMPACTS OF V-CHARACTERISTICS ON BIG DATA

The new V-characteristics of big data are emerged for acquiring knowledge from the big data more efficiently. The addition of new V-characteristics is increasing the dimensionality of the big data which in turn reduces the complexity of the data. The each V's (dimension) acquires specific information from the data that can be reused avoiding the redundant data processing. The selection of V-characteristics plays major role in big data analytics. Thus the big data can be easily fit into the big data frameworks or data servers or techniques well. The each dimension specifically possess the knowledge of big data in a specific view, therefore reduces the complexity of big data. It will further helpful in decision making, knowledge prediction, Data Analytics.

VI. CONCLUSION

This paper reviewed the V-characteristics of Big Data for knowing the evolutionary stages of Big Data and Big data opportunities. This review summarizes that even the basic V's volume, variety and velocity still make the best part in big data analytics but none of these stand on their own. The V's are reviewed right from the 3 V's upto 54 V's in this

paper. Studying various characteristics of big data will assist the researchers to analyze the big data but the key point is to know about the breakthrough in the technology of handling big data in terms of storing, accessing and analyzing. The data grows exponentially, as the result of their organization growth. Nowadays the data are of complex nature. Knowing about the nature is entirely depends on the analytical requirements of the applications. This paper reviews the existing V's of Big data on different fields, also suggested those V's to other domains in order to showcase the opportunities of big data analytics in those fields.

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