

# Revising the DIKW Pyramid and the Real Relationship Between Data, Information, Knowledge, and Wisdom

Heather J. Van Meter<sup>1</sup>

Willamette University, United States

## Abstract

This paper offers a critique and reformulation of the data-information-knowledge-wisdom (DIKW) pyramid. Today, collection of personal, business, industrial, and other types of data has never been more pervasive and invasive. Data storage now is measured in yottabytes (56 septillion bits of data) and beyond. This collected data is interrogated, monetized, hacked, and otherwise handled and mishandled around the world at an increasingly rapid pace due to improvements in technology. The interrogated data becomes information, but whether this information is useful or valuable depends entirely on the manner of interrogation and the accuracy of the underlying data. In turn, information could become knowledge but not necessarily, and not necessarily useful knowledge either. Knowledge and wisdom are also closely related, but wisdom typically contains a volume and longevity of collected knowledge and a purpose. Are humans more knowledgeable or wiser for today's massive amounts of collected data? This paper examines the traditional DIKW pyramid and proposes a revised DIKW relationship based on a Venn diagram to better reflect the relationship between data, information, knowledge, and wisdom.

**Keywords:** Data collection; information; knowledge; wisdom; DIKW.

## 1. Introduction

Collection of personal, business, industrial, and other forms of data has never been more pervasive and invasive. Data storage previously was measured in megabytes (eight million bits of data), but now it is measured in yottabytes (56 septillion bits of data), zettabytes, and beyond. Multimillion-square-foot data farms around the world, and many smaller data farms nearly everywhere, store this unimaginable volume of information.<sup>2</sup> With this massive amount of data collection, one should ask, "what is data being used for and is it creating increased knowledge or wisdom?"

This fundamental question in the new data age certainly has two tracks, only one of which is addressed in this paper. First, a more functional view of data collection and its use would consider whether physical human life has been improved with data collection and information gained from it. The answer to this question is that usefulness, as with beauty, is in the eye of the beholder. Data collection for commercial purposes has spawned whole new industries, generated hundreds of billions in revenues, employed vast numbers of people, and online ads based in part on the data collected now contributes to a largely free internet.<sup>3</sup> For example, when one shops online at Amazon or other online retailers and suggested items to purchase pop up based on past visits or past searches or based on predictive analytics, it could be useful or incredibly annoying to that person. Certainly, the pop ups and collected data behind them are useful to Amazon and other online retailers if the suggested items are purchased.<sup>4</sup> North American healthcare provider Kaiser Permanente routinely uses patient information to improve patient

<sup>1</sup> Heather J. Van Meter, Ph.D., Contributing Assistant Professor, Willamette University Atkinson Graduate School of Management, Salem, Oregon, United States; and Senior Assistant Attorney General and trial attorney, Oregon Department of Justice, Portland, Oregon, United States. The author's opinions are her own and not those of the Oregon Department of Justice or Oregon's Attorney General.

<sup>2</sup> Menear, "Top 10."

<sup>3</sup> Marvin, "Big Data Market."

<sup>4</sup> Anderson, "On-Screen Pop-Ups."



safety, reduce adverse outcomes, reduce drug interactions, and improve overall health outcomes.<sup>5</sup> Conversely, data collection can be stolen and misused against a person, opening the person up to embarrassment, theft, extortion, or worse.<sup>6</sup> This functional view of data collection is a serious and heavily debated consideration, but not addressed in this paper.

This paper addresses the epistemological aspects of data and knowledge, specifically investigating the distinctions between data, information, knowledge, and wisdom, and whether the massive accumulations of data in today's society necessarily are increasing human knowledge and wisdom. In other words, will wisdom at the top of the pyramid grow bigger because data at the bottom of the pyramid also does? The existing data-information-knowledge-wisdom (DIKW) pyramid structure (see Figure 1) assumes this will occur: data begets information, which begets knowledge, which begets wisdom; and the greater the amount of data the greater the amount of information, knowledge, and wisdom. Additionally, the DIKW pyramid assumes that all data and all information have value, and does not appear to make allowance for the effects of false or inaccurate data and information, and the possibility that increasing false and inaccurate data and information may actually reduce knowledge and wisdom.



**Figure 1. Traditional DIKW Pyramid**

Source: Wikipedia

The accuracy of these assumptions in the DIKW pyramid is at the center of this paper. Origins of the vertical-linear-oriented DIKW pyramid can be traced back to poet T. S. Eliot and musician Frank Zappa.<sup>7</sup> More recently, in the 1980s and 1990s, the DIKW pyramid was addressed by academics including Milan Zeleny, Russell Ackoff, Harlan Cleveland, and Michael Cooley.<sup>8</sup> The DIKW pyramid, to its credit, is a simple structure, and widely used throughout academia as well as in business and industry. However, use of a simple but incorrect diagram may be detrimental in these same settings by perpetuating incorrect assumptions. Thus, investigation and consideration of the assumptions in the DIKW pyramid regarding the ipso facto relationship between data, information, wisdom, and knowledge are warranted.

Artists, academics, scientists, and philosophers have been considering the relationships between information, experience and knowledge for millennia, a consideration that should and will continue. For example, the infamous scientific method, itself centuries old, is an older formulation of the relationship between data, information, and knowledge, which Isaac Newton, Francis Bacon, and others considered from Nicolaus Copernicus and Galileo Galilei, and arguably began with ancient Greek and Muslim philosophers such as Aristotle and al-Haytham. Much of the millennia-old debate surrounds the role of observation versus experience versus inherent common sense within the human experience.<sup>9</sup> Regardless, the conclusion one reaches

<sup>5</sup> Wheatley, "Transforming Care Delivery."

<sup>6</sup> St. John, "Facebook Data Breach."

<sup>7</sup> Sharma, "DIKW Hierarchy."

<sup>8</sup> Sharma, "DIKW Hierarchy."; for a discussion of antithesis, see Bernstein, "Data-Information-Knowledge-Wisdom Hierarchy"; see also Liew, "DIKIW."

<sup>9</sup> Although beyond the scope of this paper, inductivism in brief arose primarily from Bacon's work *Novum Organum*, describing the systematic enumeration and study of all instances of a phenomenon, and then extrapolating a generalization from that comprehensive study. Rationalism, attributed primarily to Descartes and Spinoza, emphasizes reason as the unique source of true knowledge. Numerous variations also exist, including empiricism or naïve inductivism, hypothetico-deductivism (attributed to Whewell), and many others. Scholarship regarding these matters has filled volumes if not small libraries over the centuries, and the debate remains as robust and important today.

regarding inductivism versus rationalism (a debate without end)—the ancient and ongoing inquiry regarding the relationship between data, information, and wisdom—has new importance with the massive data collection taking place.<sup>10</sup>

This paper analyzes each aspect of the DIKW pyramid and ultimately proposes a reconceived diagram of data, information, knowledge, and wisdom as a Venn diagram rather than a vertical pyramid to more accurately conceptualize these relationships. The intended purpose of this work is to catalyze discussion among academics and within business and industry, including the technology industry and “Big Data,” regarding the necessity and value of collecting large amounts of data and whether society is benefiting from this act. An audience of legal and data science scholars as well as technology industry executives and actors should consider this paper as beginning a conversation about the purpose, necessity, scale, and consequences of our current massive data collection in this so-called “Information Age.” Currently, data seems to be collected on a massive but largely mindless basis, without consideration for downstream consequences and unintended results. Indeed, the collection of data itself has widely been questioned for over a decade.<sup>11</sup> Further, this same audience should consider whether and how massive data collection could better be utilized to increase useful information, and how more useful information could increase society’s knowledge and wisdom. Finally, the audience should consider whether the simplistic yet widely accepted DIKW pyramid is in fact overly simplified and fails to reflect the actual sources of knowledge and wisdom, thus, reconsidering whether and how today’s massive data collection contributes (or fails to contribute) to society’s increased knowledge and wisdom.

## 2. Data Collection

Data is commonly defined as facts and statistics collected together for reference or analysis.<sup>12</sup> More specific for the computer age, data is the collected sequence of signs, symbols, and facts that have meaning within a specified representational or organizational system.<sup>13</sup>

Prior to the electronics age, data previously came from surveys, health records, bank and financial records, business records (e.g., sales and customer information), census and tax records, observational data (e.g., cars going through an intersection), and experimental data (e.g., scientific experiments). However, computers brought with them a massive new source of data collection and storage. This is currently stored in zettabytes (one sextillion bytes), where one byte is a group of eight binary digits such as zeroes and ones. Electronically stored data is collected from countless sources, ranging from phone calls, emails, and Twitter feeds, to internet clicks and routine pings on a cellular phone for a person’s location. Based on common technology—including one’s cell phone and Apple Pay or bank card usage—the entirety of a person’s daily physical actions can easily be tracked. For example, this readily available data can tell us that a user:

- leaves their house at 7.45 am (location service on cell phone and car)
- stops at Starbucks for a flat white and breakfast sandwich (purchase on Starbucks cash register and paid by bank card)
- parks their car and takes a train to work (train pass tracked and security cameras capture image)
- arrives at work at 8.30 am (train pass tracked and security badge swiped at work)
- logs in to their work computer (login and all usage tracked by employer)
- buys a grilled chicken burrito at noon at Guzman y Gomez (purchase on restaurant cash register and paid by bank card)
- engages in lunchtime internet surfing on their smartphone for more comfortable work shoes (all websites use tracking and cookies to suggest purchases)
- heads back to work at 1.00 pm (security badge swiped)
- logs back in to their work computer (tracked by employer)
- leaves work to catch the 5.25 pm train home (train pass tracked and security cameras capture image)
- visits a local pub with friends and has two pints (purchase on pub cash register and paid by bank card, and cell phone location tracked)
- picks up salmon and salad for dinner from ALDI (purchase tracked by ALDI and paid by bank card)
- binge watches Netflix that evening (Netflix usage and programs tracked and paid by bank card)
- meditates using the Calm app at 9.45 pm (Calm app usage tracked, paid by bank card).

According to *Wired*, the breadth and depth of personal data collection goes well beyond what most consumers see when an ad follows them while browsing online, even beyond presumptive tracking of a cell phone user’s location, to include where on a website a computer user hovers their cursor and the unique user tapping of a smartphone keyboard.<sup>14</sup> For example, the popular genomics company 23andMe collects DNA samples and provides customers with personalized DNA information linking their

<sup>10</sup> Ahsan, “Data, Information, Knowledge and Wisdom.”

<sup>11</sup> Spence, “Information, Knowledge and Wisdom.”

<sup>12</sup> Oxford Dictionary, “Data.”

<sup>13</sup> Zins, “Conceptual Approaches.”

<sup>14</sup> Matsakis, “WIRED Guide.”

genetics and ancestry. However, most customers do not know that their DNA information may be sold to pharmaceutical or other companies eager for verified and uniquely identifiable personal DNA data for marketing and commercial purposes.<sup>15</sup> 23andMe's website reports over 10 million DNA test kits sold to date.<sup>16</sup> As Professor Englezos's paper in this volume indicates, the pervasive collection of data on individuals to attempt to create a digital "copy" of an individual can never be completely accurate.

It is neither just individual companies collecting a user's data for internal purposes. Rather, governments are collecting data on people using legal and sometimes illegal means. For example, in 2016, the United States (US) National Security Agency alone obtained 534 million records of phone calls and text messages from two telecommunications companies, AT&T and Verizon.<sup>17</sup> Unknown numbers of records were obtained from other telecommunications companies and other sources.

The collected data is also combined, recombined, packaged, sold, and redistributed. Data brokers around the world collect all types of data, including public records reflecting driver's licenses and addresses; data on marriages, births and deaths; DNA information; internet browser history, social media usage and posts; credit card purchases; and online surfing and shopping behavior—virtually any data point that can be obtained and stored, all to be resold to commercial companies or others for a fee.<sup>18</sup> American companies alone spent approximately USD\$19 billion in 2018 for acquiring and analyzing consumer data.<sup>19</sup> Indeed, one of the biggest economic growth opportunities in developed and developing countries is building data farms to store the exponentially growing collected data, including giant data farms in India, Norway, the US, and four of the world's largest data farms in China.<sup>20</sup> Collected data is stored, interrogated, monetized, hacked, and otherwise handled and mishandled around the world at an increasingly rapid pace thanks to improvements in technology and computer processing speeds.

The infamous WikiLeaks scandals, outing names of spies and confidential diplomatic communiqués and war activities, highlights some of the dangers of misuse of collected data. Founder Julian Assange was recently arrested after leaving his safe haven in Ecuador's embassy in London.<sup>21</sup> However, data collection can appear in more benign-seeming forms. A recent ad for J.Crew, a once-popular preppy clothing company, touts the collection of personal data for an "enhanced customer experience," with an elaborate data-collecting loyalty rewards program.<sup>22</sup> Additional dangers include revealing private phone numbers, addresses, personal photos, bank account and credit card numbers, or other personal information for theft or extortion or other criminal acts by co-workers, IT hackers, third-party contractors, government employees, and even law enforcement.

Data is not only subject to misuse and abuse, but is also often inaccurate, or unintentionally or intentionally false. Hospitals, insurance companies, banks, and other companies are constantly requesting current and accurate information for customers, because the information they have is outdated. Online purchases require updated, correct mailing addresses for delivery. Grocery stores, restaurant chains, and other brick-and-mortar companies request phone numbers, addresses, and other personal information, ostensibly for a customer loyalty program but in reality as part of the company's larger customer data collection for marketing, sales, and possibly other purposes. Indeed, the data may be outdated or even intentionally inaccurate. Well-known consumer organization Consumer Reports recommends lying to protect personal data.<sup>23</sup> The author uses a relative's account for grocery store loyalty program discounts, leading the grocery store to collect purchasing data on and offer coupons to the wrong person. Further, people routinely lie during data collection. They lie on surveys such as health or business surveys, and regularly lie to pollsters and telemarketers, and even on restaurant reviews.<sup>24</sup> In fact, for two weeks in 2017 a nonexistent restaurant was the most sought-after dinner reservation in London, all based on fake posts and reviews.<sup>25</sup> Consumers' increasing distrust of companies or institutions may be both a cause and result of inaccurate data.<sup>26</sup> One may hypothesize that an increased distrust in companies and institutions might lead people to more frequently provide intentionally false data, but there is no known study regarding consumer trust and an increased or decreased willingness to provide accurate data.

Inaccurate data goes far beyond simple consumer purchasing. A recent US News article highlighted the data inaccuracies in school shootings, desegregation mandates, and civil rights information just for US primary and secondary schools, including

<sup>15</sup> Matsakis, "WIRED Guide."

<sup>16</sup> See <https://www.23andme.com>.

<sup>17</sup> Savage, "N.S.A."

<sup>18</sup> Matsakis, "WIRED Guide."

<sup>19</sup> Matsakis, "WIRED Guide."

<sup>20</sup> Menear, "Top 10."

<sup>21</sup> BBC News, "Wikileaks."

<sup>22</sup> Pearson, "J. Crew Rewards."

<sup>23</sup> St. John, "Facebook Data Breach."

<sup>24</sup> BBC News, "Small Data"; Brenner, "Lies."

<sup>25</sup> Morris, "Fake Restaurant."

<sup>26</sup> Edelman, "2020 Edelman Trust Barometer."

massive overreporting of school shootings.<sup>27</sup> The inaccuracies were caused by a combination of human errors in inputs and possibly intentionally falsified data to obtain more federal government funds.<sup>28</sup>

Thus, zettabytes of data are being collected—data from nearly every person, company, employer, and government on the planet. This data may be outdated, unintentionally or intentionally inaccurate, or accurate but misused or abused. As the early computer-age adage says, garbage in means garbage out. If the data inputs are stale or faulty or false, any information outputs from that bad data may also be faulty or false. There is no known study on whether the massive amounts of data—zettabytes of data—being collected in the computer age are more or less accurate than pre-computer data collection methods. Thus, data does not necessarily directly lead to information, and it is impossible to conclude that the zettabytes of data being collected and stored to create “information” today are actually creating more or better information.

### 3. Information

Information is commonly defined as the “[f]acts provided or learned about something or someone.”<sup>29</sup> Facts previously were provided orally and in primary and secondary written and recorded sources, such as the dates and descriptions of historical events in letters or documents (Magna Carta and Federalist Papers); births, marriages, and deaths recorded in government records or with religious institutions; and notes or publications of observations or scientific experiment results.<sup>30</sup> These sources were not always accurate. In fact, the victor in a war was arguably entitled to write the history of the war.<sup>31</sup> Additionally, the “history” passed down of events was not always accurate by today’s standards, but strict accuracy was not always the primary goal. Often, the aim was increasing the power or legend of a leader or increasing social cohesion.<sup>32</sup> Indeed, oral storytelling was practiced in ancient times without strict adherence to accuracy as opposed to the goals of moral teaching, cultural, and historical understanding, or other goals.<sup>33</sup>

In the industrial age, with newspapers, photographs and communications devices, the standards and expectations for accuracy and “truth” in information increased. However, newspapers were famously the source of false information as well, often for the purpose of increasing sales. “Yellow journalism” or the “yellow press” was a term given to American journalism in the 1890s, when sensationalism and eye-catching headlines were used to boost newspaper sales, all based on stories that were exaggerated if not outright false.<sup>34</sup> As Samuel’s article points out, today’s internet-era “fake news” is perhaps just an updated version of the “yellow press” from over a century ago.

In the computer age, information can be defined as the meaning given by humans to collected data or selected subsets of data, typically accompanied by a presumption of truth or fact. Thus, interrogated data can become information, but whether the information is useful or valuable entirely depends on the manner of interrogation and the accuracy of the underlying data. Accurate data certainly can lead to good and useful information—from a challenging human versus computer chess match to the aforementioned Kaiser Permanente’s identifying potential causes of diseases with life-saving results. Britain’s Medical Research Council has conducted a decades-long series of health and social studies using medical records, tests, and survey results that has undoubtedly saved countless lives.<sup>35</sup>

As noted, information is only as good as the source or the data being used to gain information. If the collected data is faulty or false, intentionally or unintentionally, any interrogation of that data will produce incorrect results. A database of US school shootings that contains incorrect data inputs due to human error—such as lack of reporting or double-reporting, or incorrect dates and locations—may lead to incorrect information unless the database errors are identified and corrected.

Additionally, the means and methods of interrogating data are important—in other words, asking the right questions in the right way to gain valid and useful information from the data. The fields of statistics and now data science are dedicated to these tasks.<sup>36</sup> Data science is considered to incorporate statistical methods and include data acquisition, data storage and access, data exploration and analysis, modeling and model validation, and results reporting and usage.<sup>37</sup> As with any field of science,

<sup>27</sup> Camera, “When the Data’s No Good.”

<sup>28</sup> Camera, “When the Data’s No Good.”

<sup>29</sup> Oxford Dictionary, “Information.”

<sup>30</sup> United States National Archives and Records Administration, “History in the Raw.”

<sup>31</sup> West, “Black American Lives.”

<sup>32</sup> Eklund, “Memory and Enshrining Writing.”

<sup>33</sup> Eklund, “Memory and Enshrining Writing,” 77–79.

<sup>34</sup> Samuel, “Yellow Journalism.”

<sup>35</sup> United Kingdom Medical Research Council, “1946 Birth Cohort Study.”

<sup>36</sup> Weihs, “Data Science.”

<sup>37</sup> Weihs, “Data Science.”

obtaining valid and useful information using statistical methods and data science is a trial and *error* process. A famous 1936 *Literary Digest* “scientific” poll for the US presidential election between Franklin D. Roosevelt and Alf Landon incorrectly predicted Landon to win with 57% of the vote, but Roosevelt won with 62% of the popular vote.<sup>38</sup> This statistical blunder was likely due in part to whom the magazine chose to mail the poll (selection bias), and the fact that there was only a 25% response rate and possibly that a limited demographic chose to respond (response bias). This is but one example of a situation in which the data (the returned poll responses) was likely accurate (i.e., the responders probably answered honestly), but the collected data did not produce valid and useful information.

Misinterpretation of information is also common. For example, in human health matters one often reads of “causation” between an input and an outcome when no such causal connection can be shown. Take a human psychology study connecting watching television and body dissatisfaction among teenage girls being reported as a potential causal connection with eating disorders.<sup>39</sup> As it turns out, diet drinks are not killing you, broccoli still is good for you, eating French fries does not double one’s risk of death (which is at 100% anyway), and eating ice cream does not cause drowning.<sup>40</sup>

As well, information can easily be misinformation—inaccurate information intended to deceive. Urban legends, stories such as alligators living in sewers, or “dangerous cosmic rays passing by Earth” and keeping “electronic devices away from you,” are so commonplace that whole websites such as Snopes are dedicated to investigating these stories and reporting on their falsity or, rarely, their truth.<sup>41</sup> “Fake news” is a term popularized by US President Trump to ridicule negative stories about him, regardless their truth or falsity.<sup>42</sup> However, “fake news” is more commonly defined as intentionally false or grossly exaggerated stories, which, as Samuel suggests, is essentially today’s “yellow journalism.”<sup>43</sup> Professor Chris Dent’s research in this volume on the internet age and sources of knowledge or “truth” is readily applicable here.

Truthful information also can be incorrectly mistrusted to the point of being outright ignored. Case in point, a large group of people challenge whether the US lunar landing actually occurred or was faked, despite filming of the event, humans going to the moon and returning with rocks and stories, and the space capsule itself on display.<sup>44</sup> As the former chief historian of NASA said of the lunar landing deniers, “[t]he reality is, the internet has made it possible for people to say whatever the hell they like to a broader number of people than ever before.”<sup>45</sup> This is not to mention the outrage created by Holocaust deniers. Even a “flat Earth” society has emerged, ostensibly challenging whether the Earth is flat and not round, to the point of holding international conventions and planning a trip to the “edge of the Earth” in Antarctica.<sup>46</sup> Some of these groups are of course just seeking attention through outlandish statements. However, this mistrust of truthful information may be a natural reaction to an age of disinformation: people perhaps know that they should be skeptical of much of the information surrounding them and overreact to distrust even demonstrably truthful information.

Information, then, can exist but be inaccurate, misinterpreted, misused, outright false, intentionally false to deceive people, and completely ignored despite its obvious truth. Taking this as a given, information does not necessarily lead to knowledge, and more information does not necessarily increase knowledge. In fact, more information in the internet era may mean more disinformation and actually reduce knowledge. Therefore, information could become knowledge, but not necessarily so, and not necessarily useful knowledge. Instead, there are qualifiers: information must be both accurate and combined with experience to form the basis for knowledge.

#### 4. Knowledge

Knowledge is sometimes generally described as learned facts and theories. Plato defined knowledge as “justified true knowledge”; although, this definition leaves much room for interpretation. Knowledge also is broken into subcategories: there is (1) empirical knowledge based on experience and use of the senses; and (2) rational knowledge based on reason, collected information with intuition and deduction, and/or innate knowledge. Whole university degree programs are dedicated to the study of knowledge or epistemology such that a truly complete discussion is beyond the scope of this paper, but a working definition of knowledge is necessary to proceed.

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<sup>38</sup> Lusinchi, “Landon.”

<sup>39</sup> Goldin, “Causation vs Correlation.”

<sup>40</sup> Mayerowitz-Katz, “Health More Complicated Than Correlations.”

<sup>41</sup> Kasprak, “Dangerous Cosmic Rays.”

<sup>42</sup> Ellis, “Fake News,” 398.

<sup>43</sup> Graham, “Some Real News.”

<sup>44</sup> Godwin, “One Giant Lie?”

<sup>45</sup> Godwin, “One Giant Lie?”

<sup>46</sup> Dobson, “Flat Earth Supporters.”

Knowledge is commonly defined as the “[f]acts, information, and skills acquired ... through experience or education.”<sup>47</sup> In other words, combining rationalism and empiricism, knowledge can be defined as human understanding of some concept or thing based on synthesizing accumulated information and experience.

Several key points should be made regarding this definition. First, knowledge is a collective concept, meaning it is based on general human understanding, and not just one person’s view or belief. Second, knowledge is a synthesis of both gathered information and life experience. It is the combination of these two pathways—gathering information and experiencing life—that creates knowledge. Third, gathered information that is not confirmed by life experience may not constitute knowledge. This is especially true if the gathered information is contradicted by life experience. Fourth, knowledge is topic- or subject-specific. In other words, one can acquire knowledge on a topic through gathering information and life experience, but knowledge on one topic does not by itself lead to knowledge on other topics; instead, the process of gaining knowledge must be repeated for each discrete topic or subject. If a person is shown how to use a hammer by another knowledgeable person and then uses a hammer and materials to build a wall, this person may be knowledgeable about using a hammer to build a wall, but it does not mean the same person is knowledgeable about making a hammer, or engineering a wall, or homebuilding.

Knowledge is not an inherent human characteristic, and not necessarily even widespread or widely dispersed among humans. Proverbs 20:15, attributed to King Solomon (Jedidiah), says “gold there is, and rubies in abundance, but lips that speak knowledge are a rare jewel.” Plato’s *The Apology* attributes to Socrates an investigation of politicians, poets, and craftsmen who claim to be knowledgeable but who actually know far less than what they claim.<sup>48</sup> Bruno Latour’s meandering thought process in *Laboratory Life to Down to Earth*, considering scientists’ role in the climate change science debate, is perhaps a modern extension of Socrates’ investigation of knowledgeable people in ancient time.<sup>49</sup>

As famously inscribed on New York City’s Metropolitan Museum of Art, “knowledge is power.” Knowledge is said to separate humans from other animal species. More importantly, acquisition and use of knowledge allows humans to succeed in work and life. As described in the “hierarchy of needs” (see Figure 2), Maslow’s famous conceptualization of human motivation—the basic physiological survival needs of food, shelter, sleep, water, air, and clothing—can be met with or without knowledge; although, it is likely easier to have these basic needs met with some knowledge.<sup>50</sup> That said, needs beyond basic physiological needs require some knowledge to attain and retain.



Figure 2. Hierarchy of needs

Source: Wikimedia Commons

Certainly, safety needs require some knowledge. Economic safety needs can be met through work opportunities or ability to access other income resources, either of which requires some knowledge. Personal and commercial success at work also is increased with increased knowledge of the work being performed; that is, a construction worker is more efficient and effective and can earn more money if they are more knowledgeable about the work. Physical safety needs, including acquiring freedom from violence and natural disasters, is aided by knowledge to avoid or flee and recover from such safety threats. Health safety needs, including securing physical and mental health for one’s self, eating healthy and getting exercise, avoiding unhealthy

<sup>47</sup> Oxford Dictionary, “Knowledge.”

<sup>48</sup> Plato, “Apology.”

<sup>49</sup> Latour, *Laboratory Life*; Latour, *Down to Earth*.

<sup>50</sup> Maslow, *Motivation and Personality*.

habits, and avoiding or securing treatment for mental health problems, all require knowledge. Beyond basic physiological and safety needs, obtaining love and belonging, esteem and confidence and respect, and reaching the pinnacle of self-actualization, all require knowledge.

Thus, knowledge even without wisdom is both valuable and necessary for most human activity. The more knowledge a person has, the more likely they are to have more human needs met and further experience economic and social success in his or her life. However, knowledge does not necessarily improve humanity or society as a whole. Knowledge and wisdom are closely related, but wisdom contains both a larger volume and longevity of collected knowledge as well as an application of thoughtful intelligence, therefore, combining knowledge and intelligent thought to extrapolate and apply to future events and conduct. Wisdom alone has the capacity to improve not only one's own life but also society and humanity.

## 5. Wisdom

The sources and existence of wisdom is a centuries-old question generating countless philosophical books and essays, a summary of which is beyond the scope of this paper. Aristotle, in *Nicomachean Ethics Book VI*, distinguished between theoretical and practical (life) wisdom, and considered theoretical wisdom to require knowledge of certain scientific principles and propositions.<sup>51</sup> However, knowledge, even extensive scientific knowledge, does not necessarily beget wisdom. First, a working definition of wisdom is necessary.

Wisdom is commonly defined as “[t]he quality of having experience, knowledge, and good judgment.”<sup>52</sup> To this definition one might add the adjective “extensive,” because limited amounts of these are insufficient to create wisdom. More expansively today, wisdom can be defined as the application of collected knowledge to generate an understanding of humanity and human society and its environs to guide one's actions and improve one's life. One might also include an aspect of wisdom that involves more broadly improving upon human society and environs (which likely also improves one's own life). Regardless the broader societal benefits, wisdom requires but is more than mere collected knowledge. Importantly, wisdom does not mean totality or perfection in knowledge or thought. Indeed, Plato's discussion of Socrates' wisdom in *The Apology* indicates that perhaps a wise person knows when he or she does not know something and accepts being incorrect.

As with knowledge, several observations of the definition of wisdom can be made. First, wisdom is defined as a human quality or trait, person-specific, and not universally or even widely held. Wisdom as a human quality can be acquired, but also lost. Second, wisdom is created through information, experience, and knowledge plus the human input of analysis and extrapolation. Intelligent use of the information, experience, and knowledge is vital to wisdom. Third, wisdom as a quality must be observed and recognized by others—one person cannot simply declare himself or herself wise. Fourth, wisdom is a personally held human trait but used for improving at least one's own life if not also improving human society and environs. Finally, wisdom involves guiding one's future actions and is, thus, predictive and forward-looking.

E. O. Wilson aptly summarized today's challenge: “we are drowning in information while starving for wisdom.”<sup>53</sup> According to I Kings in the Bible, King Solomon (Jedidiah) was given wisdom at an early age by God. Today, wisdom is commonly accepted as an attribute of Socrates, Maimonides, Galilei, da Vinci, Einstein, Gandhi, and others, regardless of divine intervention. Wisdom is often attributed to famous mathematicians and scientists, such that Aryabhata, Galileo Galilei, Sir Isaac Newton, Thomas Edison, Albert Einstein, and others who have excelled in the realm of math, science and astronomy, were all geniuses, and *may* also have been wise. Thus, we now consider wisdom not necessarily as divinely granted but rather or also acquired through decades of life experience combined with intelligence and use of the available data, information, and knowledge. Regardless the source, it is widely accepted that wisdom is a rare thing.

Confusingly, the term “wisdom” is often used in a manner that is inaccurate or inappropriate. For example, in one article discussing the issue of women and work–life balance, the binary choice of “wisdom or whining” is presented, when neither wisdom nor whining is an accurate depiction of the situation.<sup>54</sup> Similarly, in the field of social work, discussion of using knowledge effectively is referred to as wisdom, when again this is an inaccurate use of the term.<sup>55</sup> Another article, in the field of architecture, refers to “wisdom” of the use of wind-catcher technology for domestic structure cooling, when the correct term would be knowledge.<sup>56</sup> Wise is not to be confused with knowledgeable, smart, important, “successful,” famous or infamous,

<sup>51</sup> Aristotle, *Nicomachean Ethics*, Book VI.

<sup>52</sup> Oxford Dictionary, “Wisdom.”

<sup>53</sup> Wilson, *Consilience*, 294.

<sup>54</sup> Greenblatt, “Work/Life Balance.”

<sup>55</sup> Klein, “Practice Wisdom.”

<sup>56</sup> Suleiman, “Direct Comfort Ventilation.”



philosophical, a “historical figure,” or even the modern “social media influencer.” Kim Kardashian is famous—but possibly not wise. Wisdom is much more complex, uncommon, and not entirely achievable based on mere personal effort.

Even if an agreed-upon definition of wisdom is reached, an agreed-upon comprehensive list of wise persons is impossible. Two shortcomings of wisdom are that it is a rare human quality and not always fully recognized or utilized by society. Leonardo da Vinci and Galileo Galilei are now widely considered to have been wise, but both were also persecuted by the Catholic Church. Wisdom is also a distinct concept from religious or spiritual enlightenment. Buddha, Moses, Confucius, Jesus, and Mohammed are all generally recognized in their respective religious faiths as having been enlightened, or, in other words, divinely touched at birth or later in life with a rare clarity of understanding and acceptance of the human condition.

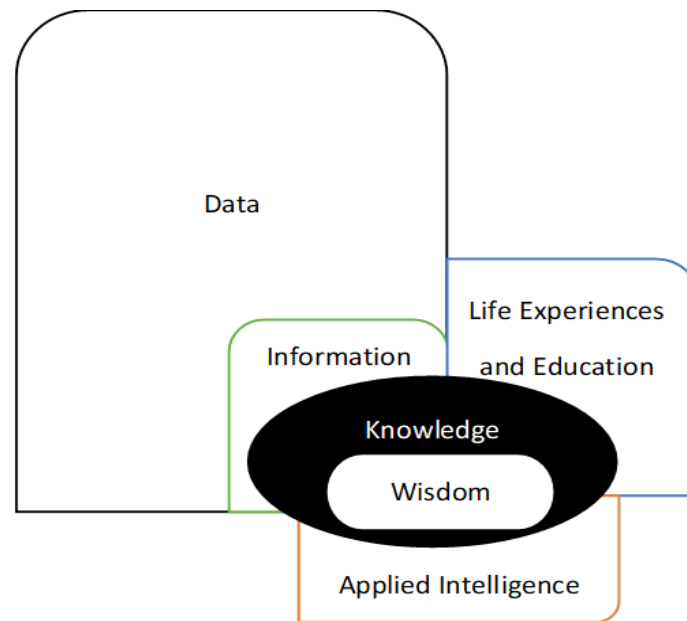
As noted, the purpose and use of wisdom is applying one’s experience, intellect, information, and knowledge in combination for improvement. Wisdom is the only part of the DIKW framework that involves an improvement of one’s life, or possibly a broader improvement of human life and environs. However, wisdom is not merely built on accumulation of data and information; thus, its place atop a vertical-linear pyramid is certainly inaccurate.

## **6. A Vertical DIKW Pyramid is Inaccurate**

Given the foregoing, a vertical-linear DIKW pyramid does not make sense. A direct line cannot be drawn from data to wisdom. Indeed, a direct line cannot even be drawn from data to information.

Data as a category is certainly large and growing, but it does not necessarily form the “base” for information let alone knowledge or wisdom. As discussed, data can be inaccurate or false. Thus, the collection of large and ever-growing amounts of data also necessarily include collection of large and ever-growing amounts of inaccurate or false data. To date, there is no known study of whether the ratio of inaccurate or false data has remained constant with the overall growth in data collection. It may be that the ratio has decreased or remained the same, but perhaps the ratio of inaccurate and false data has increased, perhaps as a human response or backlash to the collection of data itself. Therefore, the collection of data is not useful. What is actually valuable and needed *if* data is to be mass collected is the better collection of accurate and truthful data. The foregoing of course assumes that a goal, if not *the* intellectual goal, is gaining knowledge and wisdom. If mere data collection is the goal, as it is for companies earning profits based on creation and maintenance of large data farms, then data collection for those companies should and must proceed.

Information, if accurate, is a more correctly identified input toward knowledge. Yet, inaccurate, misunderstood, misused, or false information is a real problem, and detracts from rather than increases knowledge. Knowledge is acquired information, skills, and education in a particular field or area, but is limited to that field or area. Knowledge requires information but also requires skills or education. Wisdom is intelligence applied with accumulated knowledge for the benefit of humanity and human environs, and further requires knowledge along with application of intelligence. With the above-discussed loose relationships between data, information, knowledge, and wisdom, the real relationship between data, information, knowledge, and wisdom can best be pictorially represented as in Figure 3.



**Figure 3. Reconfigured DIKW diagram**

Based on the foregoing, this proposed nonlinear diagram involving data, information, knowledge, and wisdom better represents the relationship between data and wisdom. In coming years, the data box likely will grow exponentially, but it remains to be seen whether any other boxes increase in size. Perhaps more importantly, this more accurate diagram of the relationship of data, information, knowledge, and wisdom could better guide educators and others toward increasing knowledge and wisdom, with the personal and societal benefits that entails, rather than simply increasing data collection and information

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